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DEVELOPING A STATE WATER PLAN

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GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1970

COOPERATIVE INVESTIGATIONS REPORT NO. 8

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GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1970

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by

C. T. Sumsion and others

United States Geological Survey

Prepared by the United States Geological Survey

in cooperation with the State of Utah

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Utah Department of Natural Resources

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CONTENTS

	Page
Introduction	1
Utah's ground-water reservoirs	3
Summary of conditions	7
Major areas of ground-water development	10
Cache Valley by L. J. Bjorklund	10
East Shore area, Weber Delta and Bountiful districts by E. L. Bolke	11
Jordan Valley by R. W. Mower	12
Tooele Valley by L. R. Herbert	13
Utah and Goshen Valleys by R. M. Cordova	14
Juab Valley by R. G. Butler	14
Sevier Desert by R. W. Mower	15
Sanpete Valley by R. G. Butler	16
The upper and central Sevier Valleys by G. W. Sandberg	16
Pavant Valley by R. W. Mower	17
Cedar City Valley by G. W. Sandberg	18
Parowan Valley by G. W. Sandberg	19
Escalante Valley by G. W. Sandberg	19
Milford district	19
Beryl-Enterprise district	20
Other areas by R. G. Butler	21
References	22
Illustrations	23

ILLUSTRATIONS

Figure	Page
1. Map of Utah showing areas of known or potential ground-water development	5
2. Map of Cache Valley showing change of water levels from March 1969 to March 1970	24,25
3. Graphs showing relation of water levels in well (A-12-1) 29cab-1 to discharge of the Logan River near Logan and to cumulative departure from the 1931-60 normal annual precipitation at Logan Utah State University	26
4. Map of the East Shore area, Weber Delta and Bountiful districts showing change of water levels from March 1969 to March 1970	27
5. Graphs showing relation of water levels in wells near Bountiful, Layton, Clearfield, Ogden, and Plain City to cumulative departure from the average annual precipitation at Ogden Pioneer powerhouse	28
6. Graphs showing estimated population of Salt Lake County, water withdrawn from wells, and annual precipitation at Midvale for the period 1932-69	29
7. Map of the Jordan Valley showing change of water levels from February 1969 to February 1970	30
8. Graphs showing relation of water levels in selected wells in the Jordan Valley to cumulative departure from the 1931-60 normal annual precipitation at Silver Lake Brighton	31
9. Map of Tooele Valley showing change of water levels in artesian aquifers from March 1969 to March 1970	32
10. Graphs showing relation of water levels in selected wells in Tooele Valley to cumulative departure from the 1931-60 normal annual precipitation at Tooele	33
11. Map of Utah and Goshen Valleys showing change of water levels in the water-table aquifers from March 1969 to March 1970	34,35
12. Map of Utah and Goshen Valleys showing change of water levels in the shallow artesian aquifer in rocks of Pleistocene age from March 1969 to March 1970	36,37

ILLUSTRATIONS--Continued

Figure		Page
13.	Map of Utah and Goshen Valleys showing change of water levels in the deep artesian aquifer in rocks of Pleistocene age from March 1969 to March 1970	38,39
14.	Map of Utah and Goshen Valleys showing change of water levels in the artesian aquifer in rocks of Tertiary age from March 1969 to March 1970	40,41
15.	Graphs showing relation of water levels in selected observation wells in Utah Valley to cumulative departure from the 1931-60 normal annual precipitation at Utah Lake Lehi and Payson	43
16.	Map of Juab Valley showing change of water levels from March 1969 to March 1970	44,45
17.	Graphs showing relation of water levels in wells (D-11-1)9bbb-4 and (C-15-1)12aba-1 to cumulative departure from the 1931-60 normal annual precipitation at Nephi and Levan	46
18.	Map of part of the Sevier Desert showing change of water levels in the lower artesian aquifer from March 1969 to March 1970	47
19.	Map of part of the Sevier Desert showing change of water levels in the upper artesian aquifer from March 1969 to March 1970	48
20.	Graphs showing relation of water levels in selected wells in the Sevier Desert to cumulative departure from the 1931-60 normal annual precipitation at Oak City	49
21.	Map of Sanpete Valley showing change of water levels from March 1969 to March 1970	50
22.	Graphs showing relation of water levels in three wells in Sanpete Valley to cumulative departure from the 1931-60 normal annual precipitation at Manti	51
23.	Map of the upper and central Sevier Valleys showing change of water levels from March 1969 to March 1970 .	52,53

ILLUSTRATIONS--Continued

Figure	Page
24. Graphs showing relation of water levels in selected observation wells and of average annual discharge of the Sevier River at Hatch to cumulative departure from the 1931-60 normal annual precipitation at Piute Dam and Panguitch	54
25. Map of Pavant Valley showing change of water levels from March 1969 to March 1970	55
26. Graphs showing relation of water levels in selected wells in Pavant Valley to cumulative departure from the 1931-60 normal annual precipitation at Fillmore	56,57
27. Graphs showing concentration of dissolved solids in water from selected wells in Pavant Valley	58
28. Map of Cedar City Valley showing change of water levels from March 1969 to March 1970	59
29. Graphs showing relation of water levels in well (C-35-11)33aac-1 to cumulative departure from the 1931-60 normal annual precipitation at the Cedar City powerhouse, to annual discharge of Coal Creek near Cedar City, and to annual pumpage for irrigation in Cedar City Valley . . .	60
30. Map of Parowan Valley showing change of water levels from March 1969 to March 1970	61
31. Graphs showing relation of water levels in well (C-34-8)5bca-1 to cumulative departure from the 1931-60 normal annual precipitation at Parowan and to pumpage for irrigation in Parowan Valley	62
32. Map of the Milford district, Escalante Valley, showing change of water levels from March 1969 to March 1970 .	63
33. Graphs showing relation of water levels in well (C-29-10)6ddc-2 to cumulative departure from the 1931-60 normal annual precipitation at Milford airport, to discharge of Beaver River at Rockyford Dam near Minerville, and to pumpage for irrigation in the Milford district, Escalante Valley	64
34. Map of the Beryl-Enterprise district, Escalante Valley, showing change of water levels from March 1969 to March 1970	65

ILLUSTRATIONS--Continued

Figure	Page
35. Graphs showing relation of water levels in wells (C-35-17)25cdd-1 and (C-35-17)25dcd-1 to cumulative departure from the 1931-60 normal annual precipitation at Modena and to pumpage for irrigation in the Beryl-Enterprise district, Escalante Valley	66
36. Graphs showing relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas	67-71

TABLES

Table	Page
1. Areas of known or potential ground-water development in Utah	4
2. Well construction and withdrawal of water from wells in 1969 in major areas of ground-water development in Utah	8,9

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1970

by

C. T. Sumsion and others

U.S. Geological Survey

INTRODUCTION

This report is the seventh in a series of annual reports that describe ground-water conditions in Utah. Reports in the series are prepared cooperatively by the U.S. Geological Survey and the Utah Division of Water Resources and are designed to provide data for interested parties, such as legislators, administrators, and planners, to keep abreast of changing ground-water conditions.

This report, like the others (see references, p. 22), contains information on well construction, ground-water withdrawals, water-level changes, and related changes in precipitation and streamflow. It also contains supplementary data that are related to ground-water use in some areas. In reports of this series, the inclusion of such supplementary data as graphs showing chemical quality of water and maps showing water-table configuration is intended only for those years or areas for which applicable data are available and are important to a discussion of changing ground-water conditions.

The report includes individual discussions of the most important areas of ground-water withdrawal in the State for the calendar year 1969. Water-level fluctuations, however, are described for the period spring 1969 to spring 1970. Many of the data used in this report were collected by the Geological Survey in cooperation with the Division of Water Rights, Utah Department of Natural Resources.

The following reports dealing with ground water in the State were released by the Geological Survey during 1969:

A real extent of phreatophytes and hydrophytes in Utah, New Mexico, and Colorado, by T. W. Robinson: U.S. Geol. Survey open-file report.

Changes in chemical quality of ground water in three areas in the Great Basin, Utah, by A. H. Handy, R. W. Mower, and G. W. Sandberg, in Geological Survey Research 1969: U.S. Geol. Survey Prof. Paper 650-D, p. D228-D234.

Electrical sounding profile east of the Jordan Narrows, Utah, by
A. A. R. Zhody and D. B. Jackson, in Geological Survey
Research 1969: U.S. Geol. Survey Prof. Paper 650-C,
p. C83-C88.

Field-trip road log - Great Salt Lake and Antelope Island, by
Ted Arnow and J. W. Hood, in Guidebook of northern Utah;
Utah Geol. and Mineralog. Survey Bull. 82, p. 261-266.

Geochemistry and hydrodynamics of the Paradox Basin region, Utah,
Colorado, and New Mexico, by B. B. Hanshaw and G. A. Hill:
Chem. Geology, v. 4, nos. 1-2, p. 263-294.

Ground-water conditions in southern Utah Valley and Goshen Valley,
by R. M. Cordova: U.S. Geol. Survey open-file report.

Ground-water conditions in Utah, spring of 1969, by C. H. Baker, Jr.,
and others: Utah Div. Water Resources Coop. Inv. Rept. 7.

Ground-water hydrology of the Jordan Valley, Utah, by R. W. Mower,
in Guidebook of northern Utah: Utah Geol. and Mineralog.
Survey Bull. 82, p. 158-173.

Ground-water inflow toward Jordan Valley through channel fill in
seven canyons in the Wasatch Range near Salt Lake City, Utah,
by R. W. Mower, in Geological Survey Research 1969: U.S.
Geol. Survey Prof. Paper 650-C, p. C174-C176.

Ground-water levels in the United States, 1961-65 - Northwestern
States: U.S. Geol. Survey Water-Supply Paper 1845.

Hydrologic and climatologic data, 1968, Salt Lake County, Utah, by
A. G. Hely, R. W. Mower, and C. A. Horr: U.S. Geol. Survey
open-file rept. (duplicated as Utah Basic-Data Release 17).

Hydrologic reconnaissance of Curlew Valley, Utah, by E. L. Bolke and
Don Price: Utah Dept. Nat. Resources Tech. Pub. 25.

Hydrologic reconnaissance of Grouse Creek valley, Box Elder County,
Utah, by J. W. Hood and Don Price: U.S. Geol. Survey open-
file report.

Hydrologic reconnaissance of Sink Valley, Tooele and Box Elder
Counties, Utah, by Don Price and E. L. Bolke: U.S. Geol.
Survey open-file report.

Major thermal springs of Utah, by J. C. Mundorff: U.S. Geol. Survey
open-file report.

Salt Lake County's water resources, by A. G. Hely, in Utah Mosquito Abatement Assoc., 21st Ann. Mtg., 1968, Layton, Utah, Proc., p. 16-18.

Selected hydrologic data, Cache Valley, Utah and Idaho, by L. J. McGreevy and L. J. Bjorklund: U.S. Geol. Survey open-file report.

Water resources in the Goose Creek-Rock Creek basins, Idaho, Nevada, and Utah, by E. G. Crosthwaite: Idaho Dept. Reclamation Water Inf. Bull. 8.

UTAH'S GROUND-WATER RESERVOIRS

Small quantities of ground water can be obtained from wells throughout much of Utah, but large supplies that are of suitable chemical quality for irrigation, public supply, or industrial use, generally can be obtained only in specific areas. These areas of known or potential ground-water development are shown in figure 1 and named in table 1. Only a few wells outside of these areas yield large supplies of water of good chemical quality.

Less than 2 percent of the wells in Utah obtain water from consolidated rocks. The consolidated rocks that yield the most water are lava flows such as basalt, which contains interconnected vesicular openings or fractures; limestone, which contains openings enlarged by solution; and sandstone, which contains interconnected openings between the grains that form the rock. Most of the wells that tap consolidated rocks are in the eastern and southern parts of the State, in areas where water supplies cannot be readily obtained from unconsolidated rocks.

More than 98 percent of the wells in Utah draw water from unconsolidated rocks. These rocks may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these sizes. Wells obtain the largest yields from the coarser materials that are sorted into deposits of equal grain size. Most wells that tap unconsolidated rocks are in large intermountain basins, which have been partly filled with debris from the adjacent mountains.

TABLE 1

Areas of known or potential ground-water development in Utah
 (locations are shown in fig. 1)

<u>Area</u>	<u>Type of water-bearing rocks</u>
1. Curlew Valley	Unconsolidated
2. Park Valley	Do.
3. Grouse Creek Valley	Do.
4. Hansel Valley	Do.
5. Blue Creek Valley	Do.
6. Sink Valley	Do.
7. Malad-Lower Bear River Valley	Do.
8. Valley east of the Pilot Range	Do.
9a. East Shore area, Weber Delta and Bountiful districts	Do.
9b. East Shore area, Brigham district	Do.
10. Jordan Valley	Do.
11. Cache Valley	Do.
12. Bear Lake Valley	Do.
13. Upper Bear River Valley	Do.
14. Ogden Valley	Do.
15. Morgan Valley	Do.
16. Park City area	Do.
17. Kamas Valley	Do.
18. Heber Valley	Do.
19. North flank Uinta Mountains	Do.
20. South flank Uinta Mountains	Do.
21. Uinta Basin	Do.
22. Tooele Valley	Do.
23. Skull Valley	Do.
24. Dugway area	Do.
25. Fish Springs Flat	Do.
26. Sevier Desert	Do.
27. Rush Valley	Do.
28. Cedar Valley	Do.
29. Utah and Goshen Valleys	Do.
30. Juab Valley	Do.
31. Sanpete Valley	Do.
32. Central Sevier Valley	Do.
33. Upper Sevier Valleys	Do.
34. Deep Creek Valley	Do.
35. White Valley	Do.
36. Snake Valley	Do.
37. Pine Valley	Do.
38. Wah Wah Valley	Do.
39. Escalante Valley, Beryl-Enterprise district	Do.
40. Escalante Valley, Milford district	Do.
41. Beaver Valley	Do.
42. Cedar City Valley	Do.
43. Parowan Valley	Do.
44. Upper Fremont Valley	Consolidated
45. Lower Fremont Valley	Unconsolidated
46. Spanish Valley	Do.
47. Castle Valley (Grand County)	Do.
48. Montezuma Creek area	Consolidated
49. Kanab area	Unconsolidated
50. St. George area	Do.
51. Pavant Valley	Do.
52. Colton area	Consolidated
53. Scipio area	Do.
54. Lisbon Valley	Do.
55. Monticello area	Do.
56. Blanding area	Do.
57. Bluff area	Do.

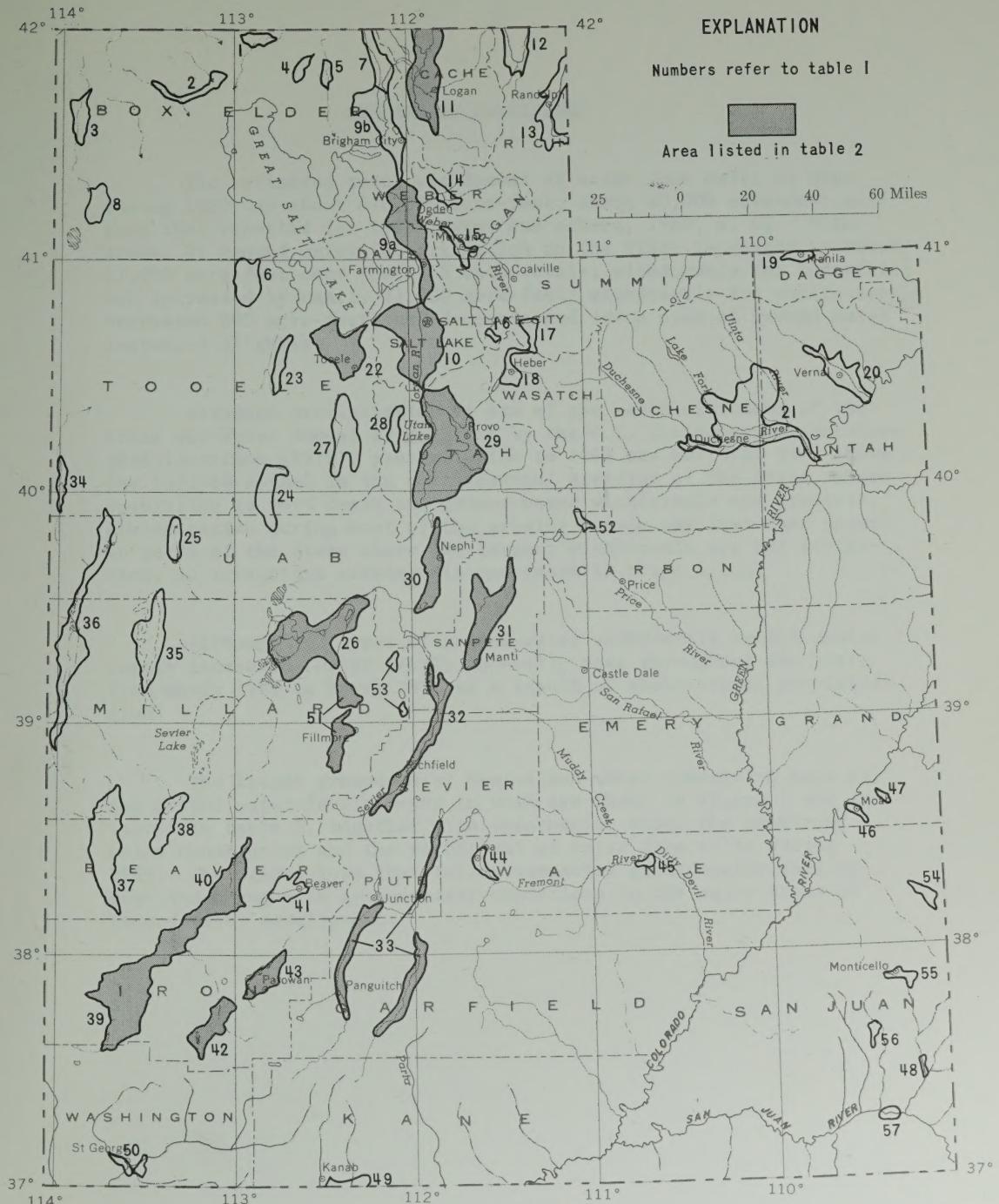


Figure 1.—Map of Utah showing areas of known or potential ground-water development.

SUMMARY OF CONDITIONS

The estimated total withdrawal of water from wells in Utah during 1969 was about 670,000 acre-feet, about 40,000 acre-feet more than that reported for 1968 (Baker and others, 1969, p. 4). Withdrawal of ground water for irrigation in the State increased by about 17,000 acre-feet over the 1968 withdrawals; withdrawals for industrial use increased by nearly 21,000 acre-feet; withdrawals for public supply decreased 800 acre-feet; and domestic and stock uses of ground water increased slightly.

Although precipitation in six of the seven divisions of the State was above normal as reported by the U.S. Environmental Services Administration (1970), precipitation in 1969 was but 0.21 inch above the 1931-60 normal in the north-central division of the State, where population is most dense and ground-water withdrawals are greatest. Precipitation during most of the growing season was less than normal in parts of the State where the largest withdrawals are for irrigation, so irrigation withdrawals increased in these areas.

Although all types of ground-water withdrawals except public supply increased, water levels generally rose throughout the State from March 1969 to March 1970 as a result of above-normal precipitation.

The larger ground-water basins and those containing most of the ground-water developments in Utah are shown in figure 1 and are listed in table 2, together with information about the number of wells constructed and the withdrawal of water from wells during 1969. The discussions that follow summarize ground-water development and changes in ground-water conditions in the major areas of ground-water development.

TABLE 2 -- Well construction and withdrawal of water from

Number in figure 1	Diameter			New large withdrawal wells ^{3/}
	Less than 6 inches ^{2/}	6 inches or more ^{2/}		
Cache Valley	11	7	13	5
East Shore area, Weber Delta and Bountiful districts	9a	23	11	2
Jordan Valley	10	18	17	3
Tooele Valley	22	3	16	2
Utah and Goshen Valleys	29	9	16	2
Juab Valley	30	0	0	0
Sevier Desert	26	4	5	4
Sanpete Valley	31	8	1	0
Upper and central Sevier Valleys	32, 33	7	10	0
Pavant Valley	51	0	5	3
Cedar City Valley	42	0	5	1
Parowan Valley	43	0	4	4
Escalante Valley				
Milford district	40	0	2	1
Beryl-Enterprise district	39	0	9	8
Other areas		6	150	21
Totals (rounded)		85	264	56

^{1/} Data from Utah Department of Natural Resources, Division of Water Rights.^{2/} Includes replacement wells.^{3/} New wells (6 inches or more in diameter) constructed for irrigation,^{4/} Includes some domestic and stock use.^{5/} Includes some use for fish and fur culture and air conditioning.^{6/} Includes some use for irrigation.^{7/} Includes some use for stock.^{8/} Estimated minimum amount.

wells in 1969 in major areas of ground-water development in Utah.

Withd rawal f rom w e l l s (a c r e - f e e t)

Irrigation	Industry	Public Supply	Domestic and stock	Total (rounded)
12,600	7,200	3,400	2,400	25,600
27,400	6,600	14,400	-	48,400
4,600	40,400	30,800	33,200	109,000
20,300	700	2,100	100	23,200
49,700	6,800	8,300	12,700	77,500
17,600	50	-	150	17,800
18,300	600	1,300	700	20,900
10,400	400	500	3,500	14,800
11,800	100	1,500	6,100	19,500
75,000	0	100	300	75,400
26,200	100	800	150	27,200
20,000	0	100	150	20,300
49,800	100	200	600	50,700
70,700	12,600	100	600	84,000
<u>46,300</u>	<u>1,200</u>	<u>7,100</u>	<u>1,000</u>	<u>56,000</u>
461,000	76,800	70,700	61,600	670,000

industrial, or municipal supply.

MAJOR AREAS OF GROUND-WATER DEVELOPMENT

CACHE VALLEY

by L. J. Bjorklund and L. J. McGreevy

Discharge from flowing wells was about the same in 1969 as in the previous two years. Pumpage, however, was moderately larger in 1969; increased usage was mainly a result of less precipitation. In 1969 precipitation was near the 1931-60 normal, whereas in 1967 and 1968 it was several inches above normal. Total discharge from all wells in Cache Valley, Utah and Idaho, was about 32,000 acre-feet in 1969 -- about 5,300 acre-feet more than the previous year and 3,400 acre-feet more than in 1967. In the Utah part of Cache Valley the total discharge from wells was about 25,600 acre-feet in 1969 -- about 3,600 acre-feet more than the previous year and 2,000 acre-feet more than in 1967 (Baker and others, 1969, p. 5).

The changes in ground-water levels in Cache Valley from March 1969 to March 1970 were generally small. In most of the valley, rises or declines in levels were less than 1 foot (fig. 2); rises or declines of more than 1 foot occurred locally. The moderate decline in water levels in the Weston area, Idaho, may have been caused, in part, by a local increase in discharge; two new large-discharge wells began operating in that area in 1969. The decline in water level in the area west of Richmond, Utah, is the result of below-normal winter precipitation.

The water level in well (A-12-1)29cab-1, near Logan, rose less than 1 foot from March 1969 to March 1970. The long-term trend of the water level in this well, shown in figure 3, is generally representative of the long-term trends of water levels in most of the valley. Annual discharge of the Logan River and the cumulative departure from the 1931-60 normal annual precipitation are shown in figure 3 for comparison.

EAST SHORE AREA, WEBER DELTA AND BOUNTIFUL DISTRICTS

by E. L. Bolke

During 1969, wells in the East Shore area discharged about 48,400 acre-feet of water, 2,000 acre-feet more than that reported for 1968 (Baker and others, 1969, p. 5); the increase is due chiefly to larger withdrawals from public-supply wells.

Water levels rose in most parts of the East Shore area from March 1969 to March 1970 (fig. 4). The greatest rises occurred near West Point, east of Hill Air Force Base along the mountain front, and east of Woods Cross and Bountiful. The greatest declines occurred in the area west of Woods Cross and East of North Ogden.

The long-term relation between precipitation and water-level fluctuations in wells is illustrated in figure 5. Despite below-average precipitation and slightly increased pumping during 1969, water levels show a net rise for the period. The general rise may be due to a prolonged period of above-average temperatures during January and February 1970. The mild winter season with an early snowmelt at intermediate elevations may have caused earlier than usual recharge to the ground-water system. Locally, in the West Point-Hill Air Force Base area, rises are partly the result of decreased pumping at individual public-supply wells.

JORDAN VALLEY

by R. W. Mower

The discharge from wells in Jordan Valley in 1969 was 109,000 acre-feet, an increase of 1,700 acre-feet, or about 2 percent, over that reported for 1968 (Baker and others, 1969, p. 6). Although the population of Salt Lake County increased by about 6,000 (fig. 6), the increased demand for public water supply was met from surface sources, and the amount of ground water used for public supply was only 30,800 acre-feet, a decrease of 6,400 acre-feet from the amount used in 1968. The largest increase in ground-water pumpage was by industry, which in 1969 used 7,400 acre-feet more ground water than that reported for 1968. The increase was due principally to a full year of milling operations by Kennecott Copper Corporation following a year in which a strike idled the mills for a few months. Ground water used for irrigation was about 10 percent more than that reported for 1968.

Water levels rose from February 1969 to February 1970 in about 55 percent of Jordan Valley (fig. 7) and declined in about 45 percent; the net average change in the valley was a rise of 0.5 foot. Maximum observed rises were slightly more than 4 feet near the eastern margin of the valley in the eastern part of Salt Lake City and east of Sandy. The largest declines were slightly more than 1 foot near the northern and the southern margins of the valley. Most of the rises were in areas where pumpage was about equal to or less than that in 1968 and where recharge was greater. In contrast, most of the declines were in areas where pumpage was more and where recharge probably was less than that in 1968.

The long-term relations between fluctuations of precipitation and water levels are illustrated in figure 8. Precipitation during 1969 was 6.75 inches above normal, and this increase accounts for the continuing steep rise in the precipitation graph. The above-normal precipitation and only moderately increased pumping in most parts of the valley are reflected by a rise of water levels in all five wells.

TOOELE VALLEY

by L. R. Herbert

The discharge of 23,200 acre-feet from wells in Tooele Valley in 1969 was about 1,500 acre-feet more than reported for 1968 (Baker and others, 1969, p. 6). The increase resulted mainly from a greater withdrawal from pumped irrigation wells.

The discharge from springs in 1969 was approximately 14,000 acre-feet. Of this amount, about 2,200 acre-feet was used for irrigation and stock in the valley, and about 11,800 acre-feet was diverted to the Jordan Valley for industrial use.

Water levels in most of Tooele Valley changed little from March 1969 to March 1970 (fig. 9). In the normally heavily pumped areas near Erda and Grantsville, water levels rose due to another year of above-average precipitation and the use of available surface water. Some declines in water levels occurred northeast of Grantsville, mainly due to the residual effect of previous pumping of wells that surround the area.

The long-term relations between water levels in selected wells and precipitation at Tooele are shown in figure 10. The precipitation at Tooele in 1969 was 3.07 inches more than the 1931-60 normal, and as a result, water levels rose in most parts of the valley. Some declines occurred in areas influenced by local pumping, however, and water levels in four of the seven wells illustrated in figure 10 showed a net decline for the year.

UTAH AND GOSHEN VALLEYS

by R. M. Cordova

The discharge from wells in Utah and Goshen Valleys in 1969 was about 77,500 acre-feet -- about 1,900 acre-feet more in Utah Valley and 1,900 feet more in Goshen Valley than in 1968 (Baker and others, 1969, p. 7). Precipitation in 1969 was above normal, but not as much above normal as in 1968. Thus the amount of supplemental water needed from wells in 1969 was greater than that required in 1968. In Goshen Valley, part of the increase in discharge for irrigation was the result of an increase in the amount of land put under cultivation.

Between March 1969 and March 1970, water levels rose in most parts of Utah and Goshen Valleys (figs. 11, 12, 13, 14, and 15). Although the withdrawal from wells was greater in 1969 than in 1968, the above-normal precipitation (fig. 15) caused an excess of recharge over discharge, resulting in the general rise in water levels.

JUAB VALLEY

by R. G. Butler

The discharge from pumped and flowing wells in Juab Valley during 1969 was about 17,800 acre-feet, 1,000 acre-feet more than that reported for 1968 (Baker and others, 1969, p. 7). This increase in the amount of water discharged from wells resulted from the pumping of some wells at Nephi and near Mona one month longer than during the previous year.

From March 1969 to March 1970 water levels rose in every well observed. The greatest changes were in the northern part of the valley and at Nephi, where water levels rose more than 5 feet, and near Levan, where water levels rose more than 4 feet (fig. 16). The rise in water levels resulted from above-normal precipitation.

The long-term relations between water levels in selected wells in Juab Valley and precipitation at Nephi and Levan are shown in figure 17. Increased precipitation as recorded at both stations, resulted in water-level rises in the wells.

SEVIER DESERT

by R. W. Mower

Total withdrawal of ground water in the Sevier Desert for all purposes during 1969 was 20,900 acre-feet, about 8,100 acre-feet less than that reported for 1968 (Baker and others, 1969, p. 8). Pumpage for irrigation in 1969 decreased 32 percent from the amount in 1968 because surface water was more plentiful in 1969.

Water levels rose in both the lower and upper artesian aquifers from March 1969 to March 1970 in most parts of the Sevier Desert (figs. 18 and 19). The maximum rise in the lower artesian aquifer was slightly more than 3 feet in the generally triangular-shaped area bounded by Delta, Lynndyl, and Oak City. The maximum rise in the upper artesian aquifer was slightly more than 3 feet in an area less than 2 miles wide, along the foot of the Canyon Mountains, extending from near Oak City to Fool Creek. Water levels in the lower artesian aquifer declined less than 1 foot near the northeastern margin of the basin north of Lynndyl and in an area about 2 to 5 miles south of Deseret. Water levels in the upper artesian aquifer declined less than 1 foot near most of both the northern and southern margins of the basin.

During 1969 the precipitation at Oak City was 4 percent above normal and probably resulted in slightly above normal recharge. This was the fifth of the past 6 years that precipitation, and thus recharge, may have been above normal. Water levels rose slightly in the three observation wells for which hydrographs are shown in figure 20, indicating that withdrawals from wells during the past year may have been less than the recharge in some parts of the Sevier Desert.

SANPETE VALLEY

by R. G. Butler

During 1969, wells in Sanpete Valley discharged about 14,800 acre-feet of water, 1,800 acre-feet more than that reported for 1968 (Baker and others, 1969, p. 8). The difference is due to increased pumpage for irrigation during 1969.

Water levels generally rose from March 1969 to March 1970 in Sanpete Valley (fig. 21); the greatest rises were in the Ephraim area and in a small area south of Mayfield. Small areas of decline occurred near Milburn, Chester, and Manti. The general rise of water levels was due to recharge from above-normal precipitation (2.22 inches above the 1931-60 normal at Manti).

Hydrographs of water levels in two pumped irrigation wells and one small-diameter flowing well in Sanpete Valley and the long-term trend of precipitation at Manti are shown in figure 22. The rises in water levels in well (D-17-3)9cbd-1, the irrigation well near Ephraim, well (D-16-3)4aaa-1, the small-diameter flowing well near Chester, and in well (D-15-4)4dda-1, the irrigation well near Mount Pleasant, reflect the above-normal precipitation during 1969.

THE UPPER AND CENTRAL SEVIER VALLEYS

by G. W. Sandberg

Wells in the upper and central Sevier Valleys discharged about 19,500 acre-feet of water during 1969, an increase of about 900 acre-feet over that reported for 1968 (Baker and others, 1969, p. 9). Water levels rose in 21 wells, declined in eight wells, and remained the same in one well from March 1969 to March 1970 (fig. 23).

The relations among water levels in selected wells, average annual discharge of the Sevier River at Hatch, and precipitation at Piute Dam and Panguitch are shown in figure 24. Precipitation at Piute Dam was above normal by nearly the same amount in 1969 as it was in 1968, but precipitation at Panguitch exceeded that in 1968 and was 2.67 inches above normal. The greatest precipitation in the headwaters area is reflected by greater discharge of the Sevier River. The slight increase in pumpage may account for the areas of small water level decline observed locally, but the general increase in water supply resulted in a general rise in water level throughout the two valleys.

PAVANT VALLEY

by R. W. Mower

The withdrawal of ground water in Pavant Valley during 1969 was 75,400 acre-feet, 20,000 acre-feet more than that reported for 1968 (Baker and others, 1969, p. 9). Pumpage for irrigation in 1969 was more than that reported in 1968 because more ground water was used to supplement irrigation supplies from streams.

Water levels declined from March 1969 to March 1970 in about 55 percent of Pavant Valley (fig. 25) and rose in about 45 percent of the valley, but there was an average net rise of water levels of 0.8 foot. In comparison, an average rise of 1.8 feet was observed from March 1968 to March 1969.

Maximum observed rises from March 1969 to March 1970 were slightly more than 6 feet in the Flowell and Meadow districts. Maximum declines were slightly more than 2 feet near the west margin of the Flowell district, near the south-central part of the McCornick district, and near the south-central part of the Kanosh district. Maximum declines were less than 2 feet in the Greenwood, Pavant, and Meadow districts.

The maximum declines in water level were in or downgradient from areas where pumped irrigation wells are concentrated and where the amount of recharge was small. The maximum rises were in areas where pumped irrigation wells are used principally to supplement surface water and where the amount of recharge was large. The relationship between water levels in selected observation wells and cumulative departure from normal precipitation at Fillmore is shown in figure 26.

The concentration of dissolved solids in ground water in Pavant Valley increased from 1968 to 1969 in wells in all the districts previously sampled. However, the concentration decreased in well (C-21-5)7cccd-3 which taps the water-table aquifer in the Flowell district (fig. 27).

CEDAR CITY VALLEY

by G. W. Sandberg

Pumpage from wells in Cedar City Valley during 1969 was about 27,200 acre-feet, about 2,400 acre-feet less than that reported for 1968 (Baker and others, 1969, p. 10). Less ground water was pumped for irrigation because of increased surface-water supplies from Coal Creek. Water pumped for other uses remained about the same as for 1968.

Water levels rose in most of the valley from March 1969 to March 1970 (fig. 28). The greatest rises were in areas recharged by water from Coal Creek and streams near Kanarraville. Declines occurred in the northern part of the valley where there is little recharge.

The relations among water-level fluctuations in well (C-35-11)33aac-1, cumulative departure from normal precipitation near Cedar City, annual discharge of Coal Creek, and annual pumpage for irrigation are shown in figure 29. The cumulative departure from normal annual precipitation has been corrected for the period 1962-69. The record at the Cedar City stream plant previously was decreased by 20 percent to make it comparable with the long-term record at the powerhouse (Baker and others, 1969, fig. 29). Reassessment of the current record by E. A. Richardson, ESSA State Climatologist, (oral commun., April 1970) indicates that the needed adjustment is about 12 percent.

The water level in well (C-35-11)33aac-1 rose for the third successive year, and the flow of Coal Creek likewise increased. Precipitation was only slightly above normal. The above-average stream discharge was due primarily to high runoff in the spring and early summer months when irrigation demands were large; and as a result, ground-water pumpage for irrigation was less than in 1968. The high spring and summer flows contributed measurably to ground-water recharge in the valley; local precipitation had only indirect effects.

PAROWAN VALLEY

by G. W. Sandberg

Wells in Parowan Valley discharged about 20,300 acre-feet of water in 1969, about 1,300 acre-feet less than that reported for 1968 (Baker and others, 1969, p. 10). The decrease was entirely in pumpage for irrigation.

Water levels in Parowan Valley changed little from March 1969 to March 1970 (fig. 30). The largest rise, more than 1 foot, was in a well about 4 miles northwest of Parowan. The largest decline, slightly more than 1 foot, was in a well north of Summit, where little or no surface water is available for recharge.

The long-term relations among fluctuations of water levels, precipitation, and pumpage are illustrated in figure 31. The rise of water level in well (C-34-8)5bca-1 was due to above-normal precipitation and surface runoff, and to decreased pumpage.

ESCALANTE VALLEY

by G. W. Sandberg

Milford district

Annual pumpage in the Milford district during 1969 was about 50,700 acre-feet, an increase of about 3,800 acre-feet over that reported for 1968 (Baker and others, 1969, p. 11). The additional water pumped in 1969 was for irrigation.

Water levels generally rose in the east side of the district and declined in the west side from March 1969 to March 1970 (fig. 32). The rise along the east side was caused by recharge from irrigation with surface water diverted from the Low Line Canal. This area normally receives little surface water, but canal supplies, as reflected by flow of the Beaver River, were available during most of the irrigation season in 1969.

The relations among water levels in well (C-29-10)6ddc-2, discharge of the Beaver River, pumpage for irrigation, and precipitation at Milford are shown in figure 33. Pumpage for irrigation in the Milford district during 1969 was the highest of record. Precipitation at Milford was greater in 1969 than in 1968, but water levels were affected little by precipitation. The rise in water levels, which was caused mostly by recharge from surface water diverted from the Low Line Canal, is indicated by the water level in well (C-29-10)6ddc-2 near the middle of the pumped area.

Beryl-Enterprise district

The amount of water pumped from wells in the Beryl-Enterprise district during 1969 was about 84,000 acre-feet, a net increase of 9,800 acre-feet over that reported for 1968 (Baker and others, 1969, p. 11). The increase was due to industrial pumping to dewater a mine area in sec. 2, T. 36 S., R. 17 W. Approximately 12,600 acre-feet of water was pumped from six wells for this purpose. This water flowed from the wells through a canal toward the north and east. Approximately 1,300 acre-feet of the water was diverted for irrigation, and the remainder flowed unused to the end of the canal in sec. 27, T. 34 S., R. 16 W.

Water pumped from irrigation wells decreased by about 2,800 acre-feet in 1969, but ground water used for irrigation decreased by only 1,500 acre-feet; the other 1,300 acre-feet was supplied from the canal. Total ground water used for irrigation was about 72,000 acre-feet.

Water levels declined less than a foot in most of the heavily pumped parts of the district from March 1969 to March 1970 (fig. 34). The large depression in the water table that appeared in 1964 continued to deepen in part of the district in Tps. 35 and 36 S.

Water levels declined more than a foot in an area of about 4 square miles east of the mine-dewatering area. Most of this decline was probably caused by pumping from the mine wells.

Water levels rose in an area north of Enterprise, in areas north and northwest of Beryl Junction, and in the northern and eastern parts of the district. The rises north of Enterprise and in the eastern part of the district are attributed to early spring runoff from the nearby hills. The rises north and northwest of Beryl Junction are attributed to seepage from the mine-drainage canal that traverses the area, to recharge from canal water spread for irrigation, and to decreased pumping of irrigation wells. Rises in the northern part of the district were probably caused by seepage from the mine-drainage canal.

The long-term relations among water levels, precipitation, and pumpage are shown in figure 35. Although precipitation was above normal, and has been since 1967, water levels continued to decline in most of the heavily pumped area. Pumpage for irrigation in 1969, although less than in 1968, was the cause of continued water-level declines throughout most of the pumped area. The rate of decline in 1969 was considerably less than during previous years as indicated by the hydrograph of well (C-35-17) 25ccd-1. The rate of decline in this well however, was probably affected by recharge from the mine-drainage water.

OTHER AREAS

by R. G. Butler

Total discharge from wells in other parts of Utah during 1969 is not known; an estimated minimum figure is 56,000 acre-feet. This figure is 8,000 acre-feet more than that reported for 1968 (Baker and others, 1969, p. 12), and the increase is due to the number of large-diameter wells completed and in use during 1969.

Water levels rose in Bear Lake, Morgan, and Cedar Valleys, and in the Blanding and Monticello areas, reflecting above normal precipitation in each of these places. Water levels remained nearly unchanged in the Dugway area, and Upper Fremont and Snake Valleys, although precipitation was well above normal (fig. 36).

Water levels rose in Park and Grouse Creek Valleys and remained nearly unchanged in Upper Bear River and Curlew Valleys, although precipitation was below normal in all these areas. In Ogden Valley, water levels rose as much as 6 feet although precipitation was more than 7 inches below normal (fig. 36). This rise in water levels resulted from loading on the underground artesian aquifer by Pine View Reservoir where the elevation of water surface was 15 feet higher in March 1970 than it was at the same period in 1969.

Water levels declined in the Uinta Basin, South Flank of the Uinta Mountains, and St. George areas, and in Beaver and Heber Valleys, although precipitation was above normal in all these areas (fig. 36).

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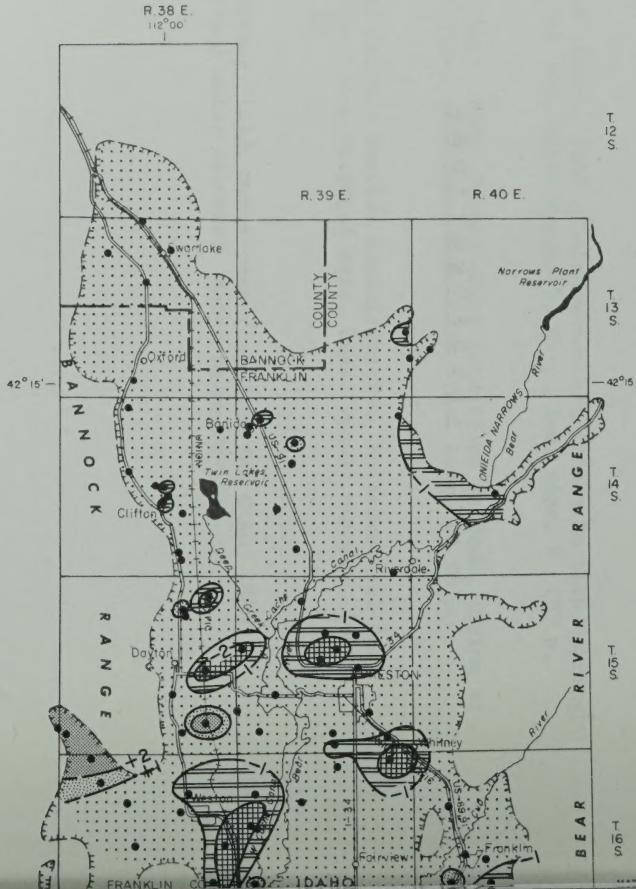
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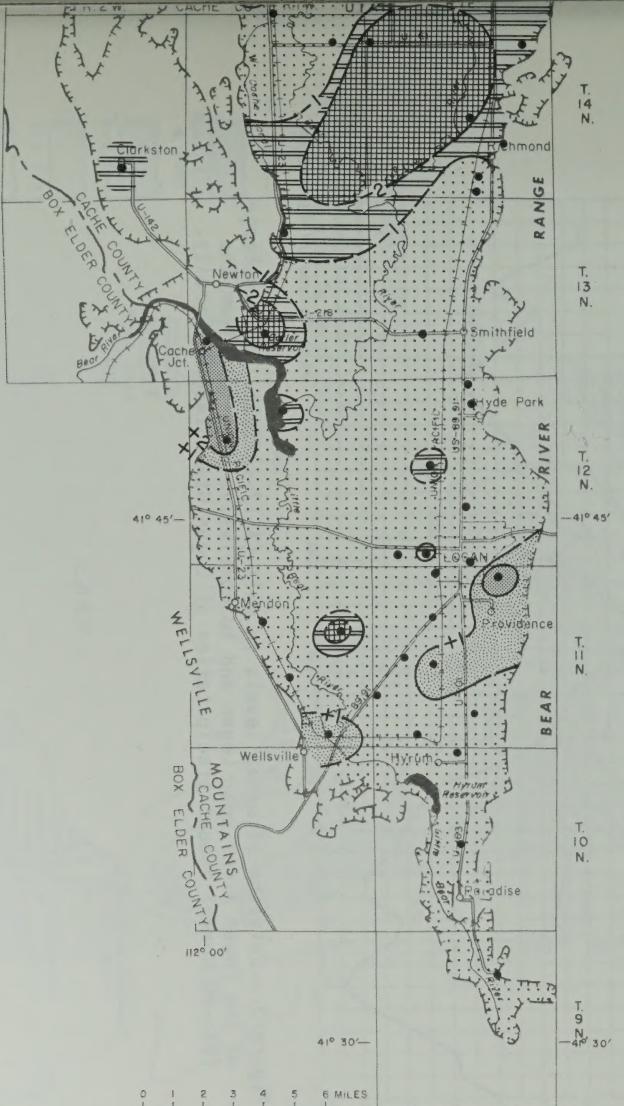
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I L L U S T R A T I O N S





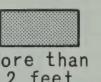
EXPLANATION

Line showing change of water level,
in feet, March 1969 to March 1970;
dashed where approximate



Little or no change
Rise or decline of less than 1 foot

Rise



More than
2 feet

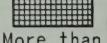
Decline



1-2 feet



1-2 feet



More than
2 feet

Observation well

Approximate boundary of valley fill

by L. J. Bjorklund

Figure 2.—Map of Cache Valley showing change of water levels from March 1969 to March 1970.

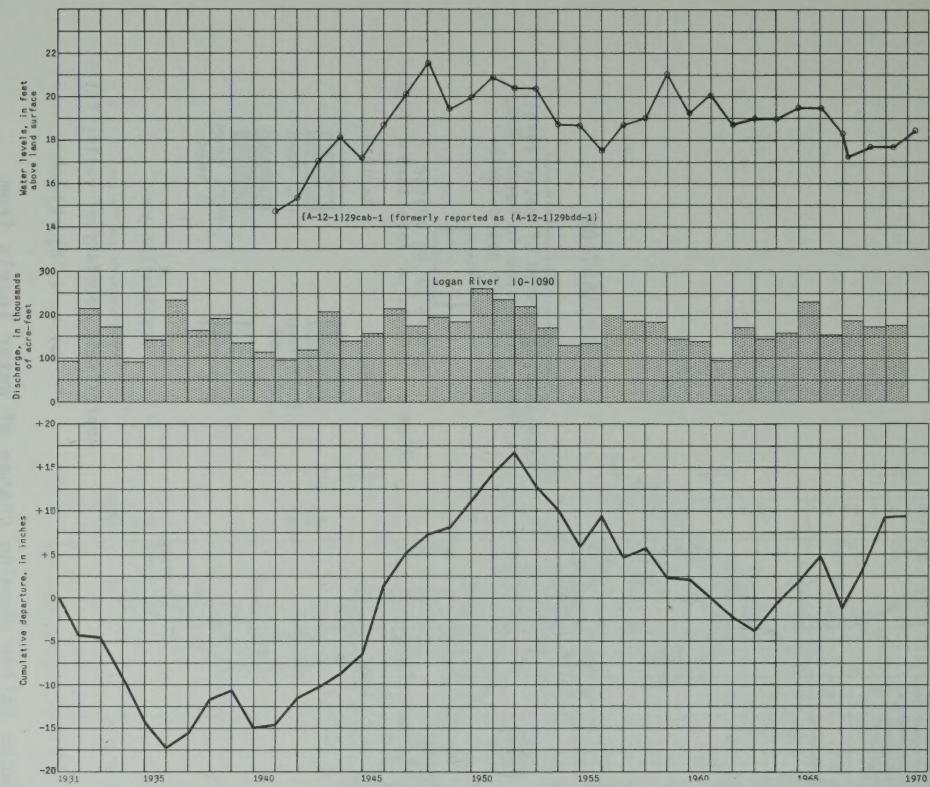


Figure 3.—Relation of water levels in well (A-12-1)29cab-1 to discharge of the Logan River near Logan and to cumulative departure from the 1931-60 normal annual precipitation at Logan Utah State University.

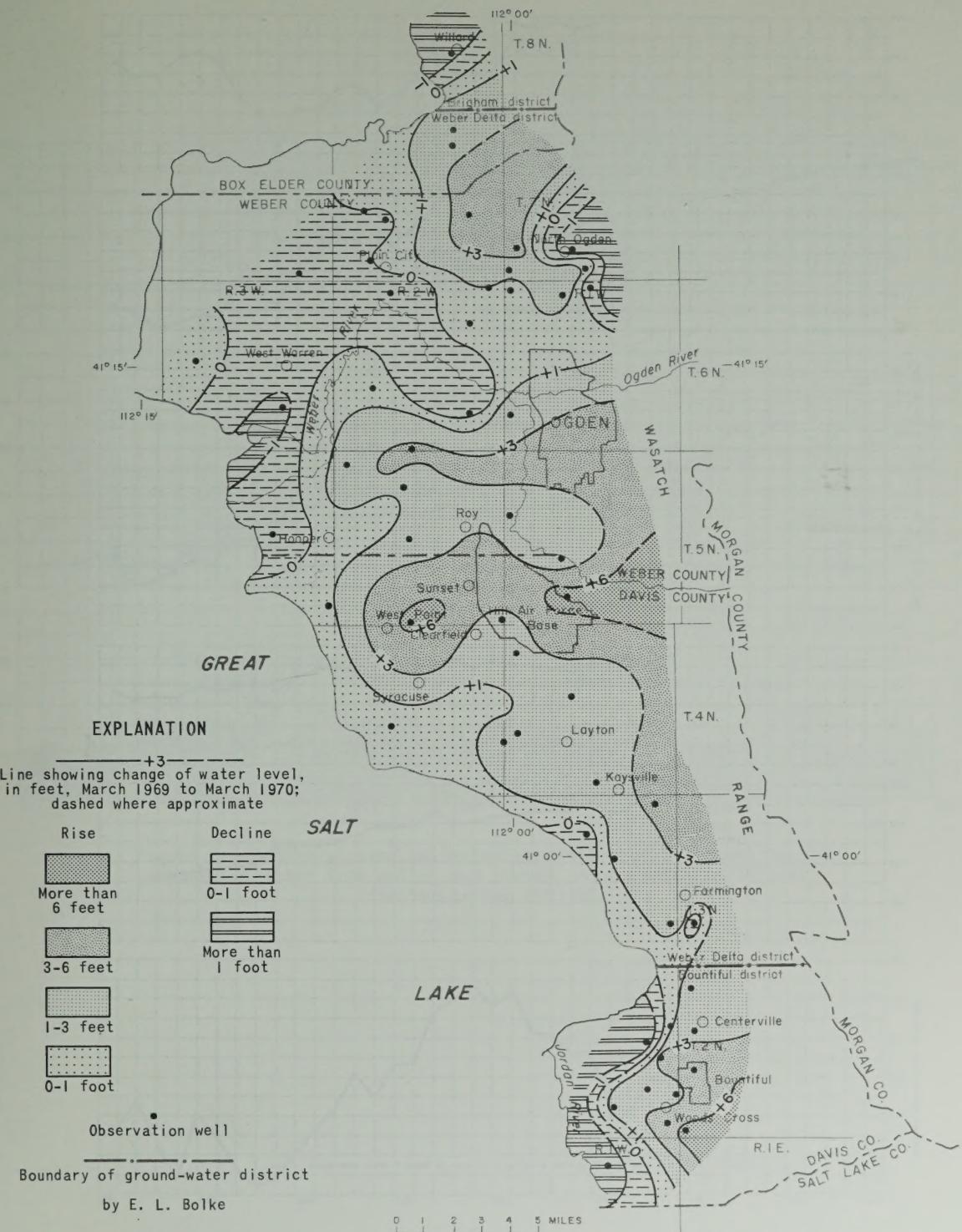


Figure 4.- Map of the East Shore area, Weber Delta and Bountiful districts, showing change of water levels from March 1969 to March 1970.

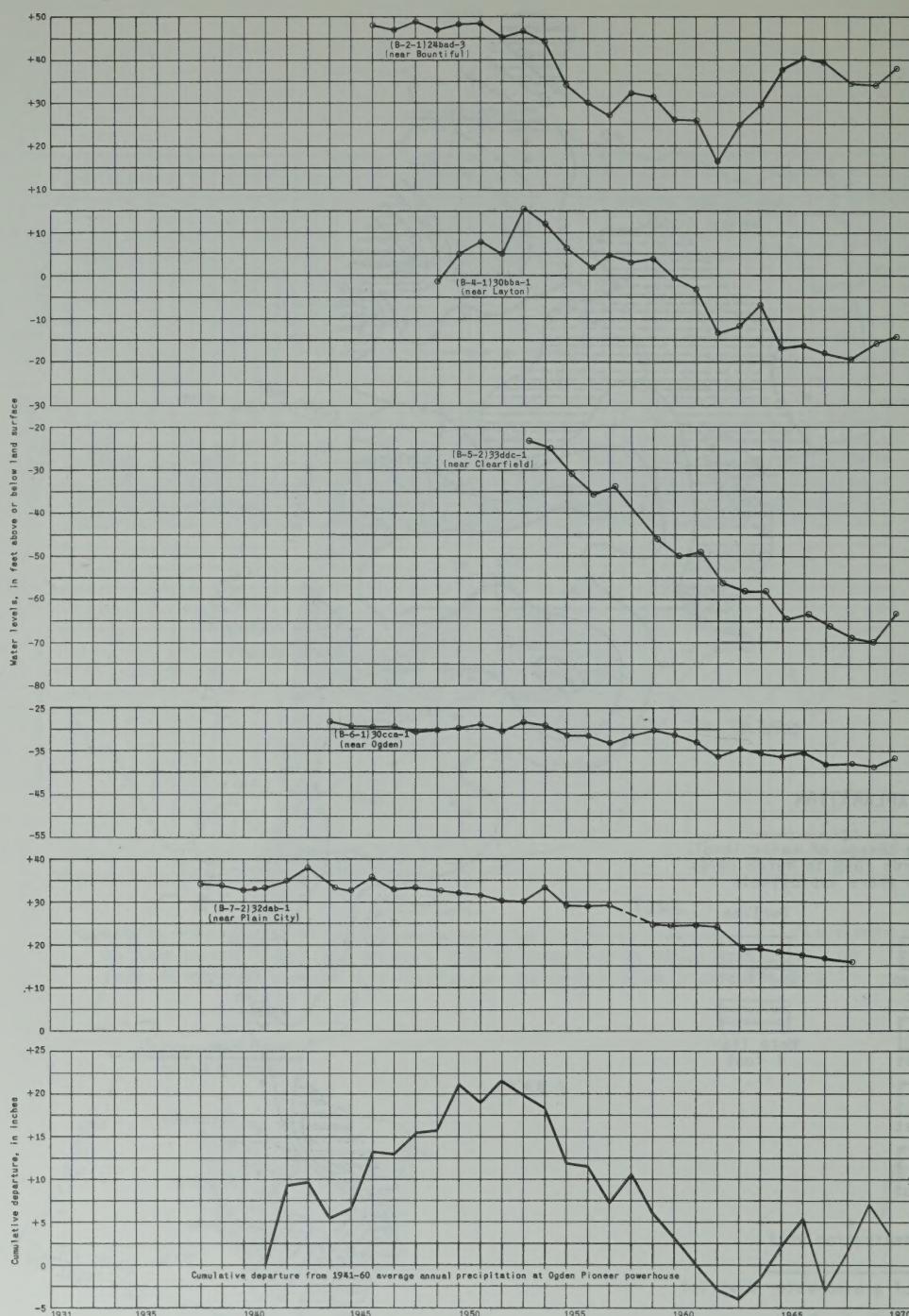


Figure 5.—Relation of water levels in wells near Bountiful, Layton, Clearfield, Ogden, and Plain City to cumulative departure from the average annual precipitation at Ogden Pioneer powerhouse.

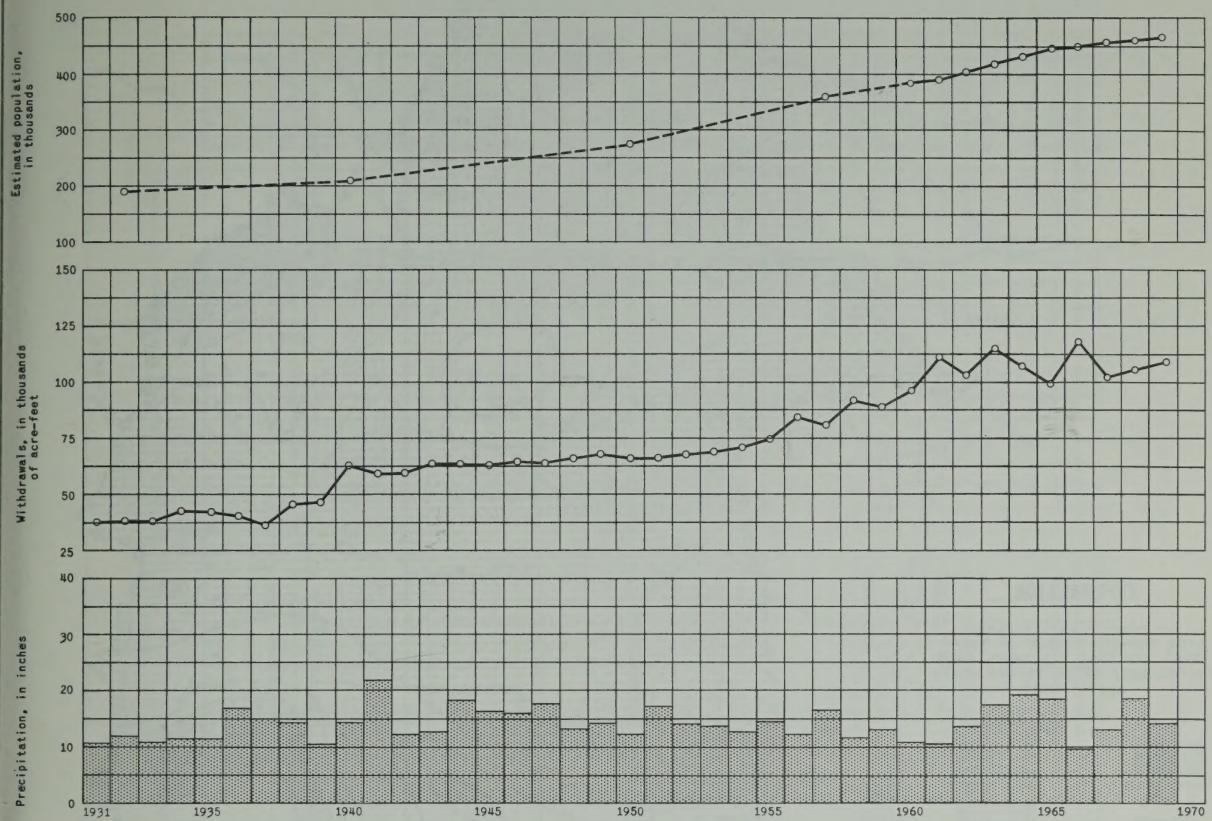


Figure 6.—Graphs showing estimated population of Salt Lake County, water withdrawn from wells, and annual precipitation at Midvale for the period 1931-69.

EXPLANATION

+1
Line showing change of water level, in feet, February 1969 to February 1970; dashed where approximate

Rise	Decline
[Solid box] More than 4 feet	[Dashed box] +1 foot
[Hatched box] 3-4 feet	[Dashed box] 0-1 foot
[Cross-hatched box] 2-3 feet	[Dashed box] -1 foot
[Dotted box] 1-2 feet	
[Dotted box] 0-1 foot	

● Observation well

— Approximate boundary of valley fill

by R. W. Mower

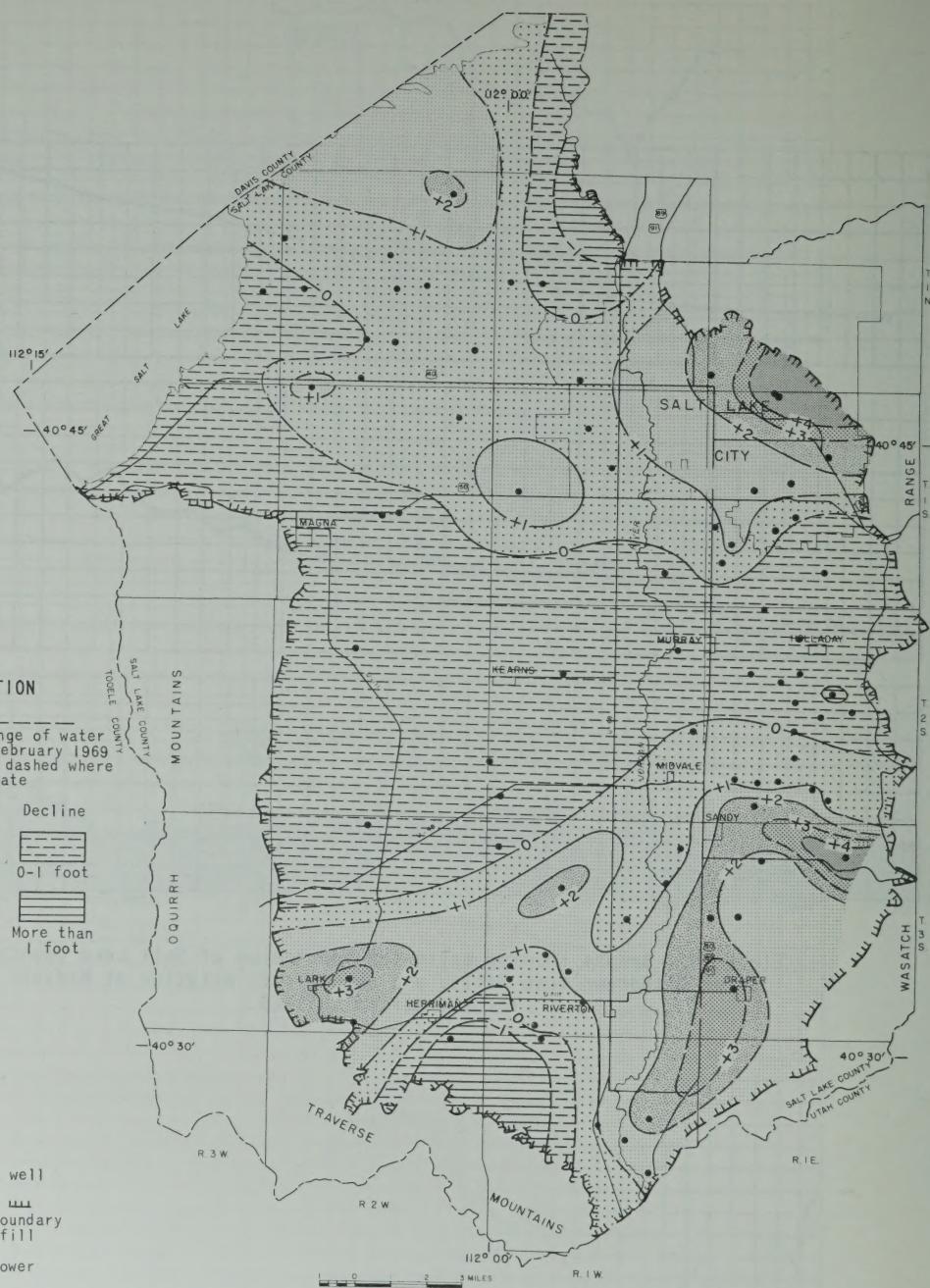


Figure 7.—Map of the Jordan Valley showing change of water levels from February 1969 to February 1970.

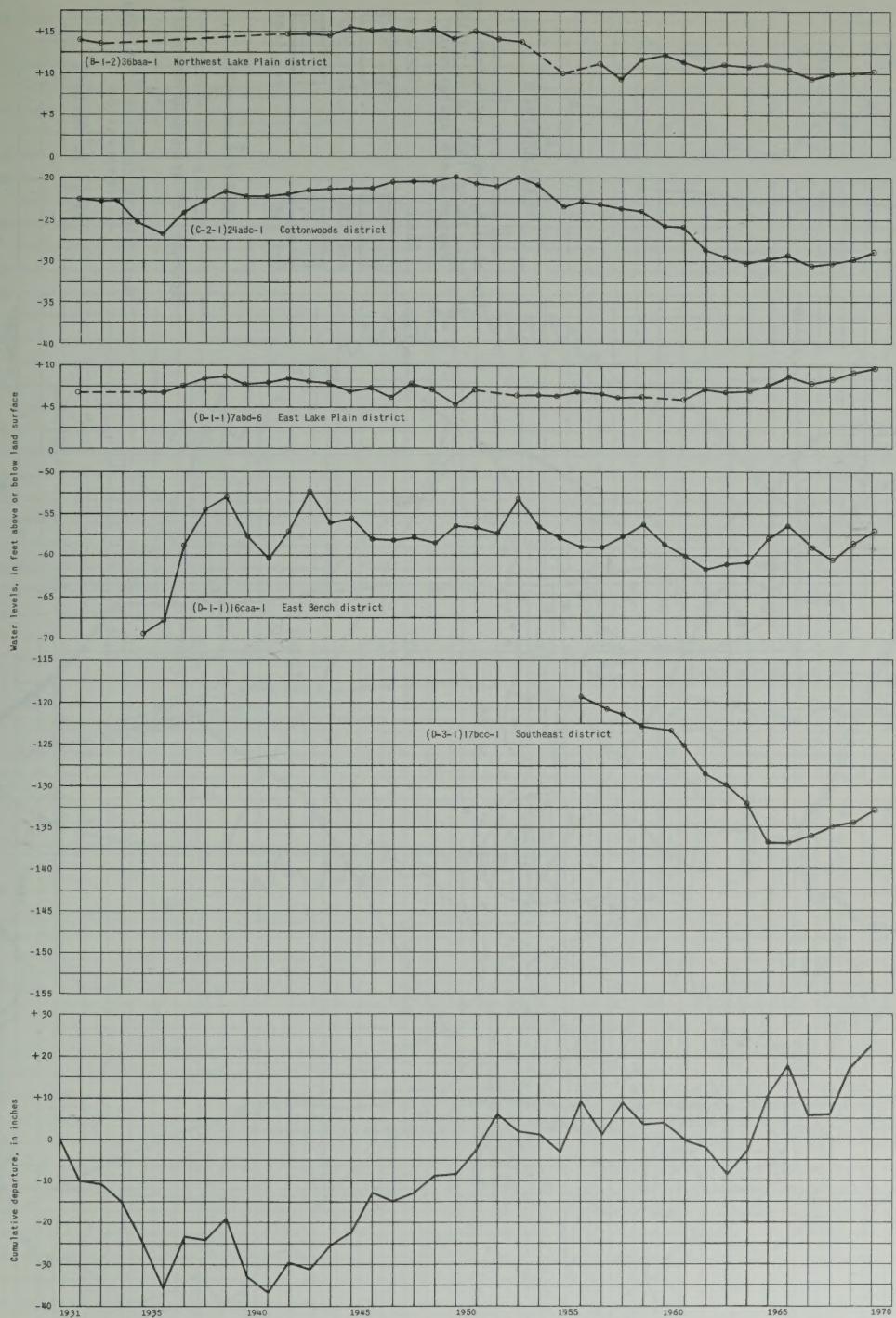
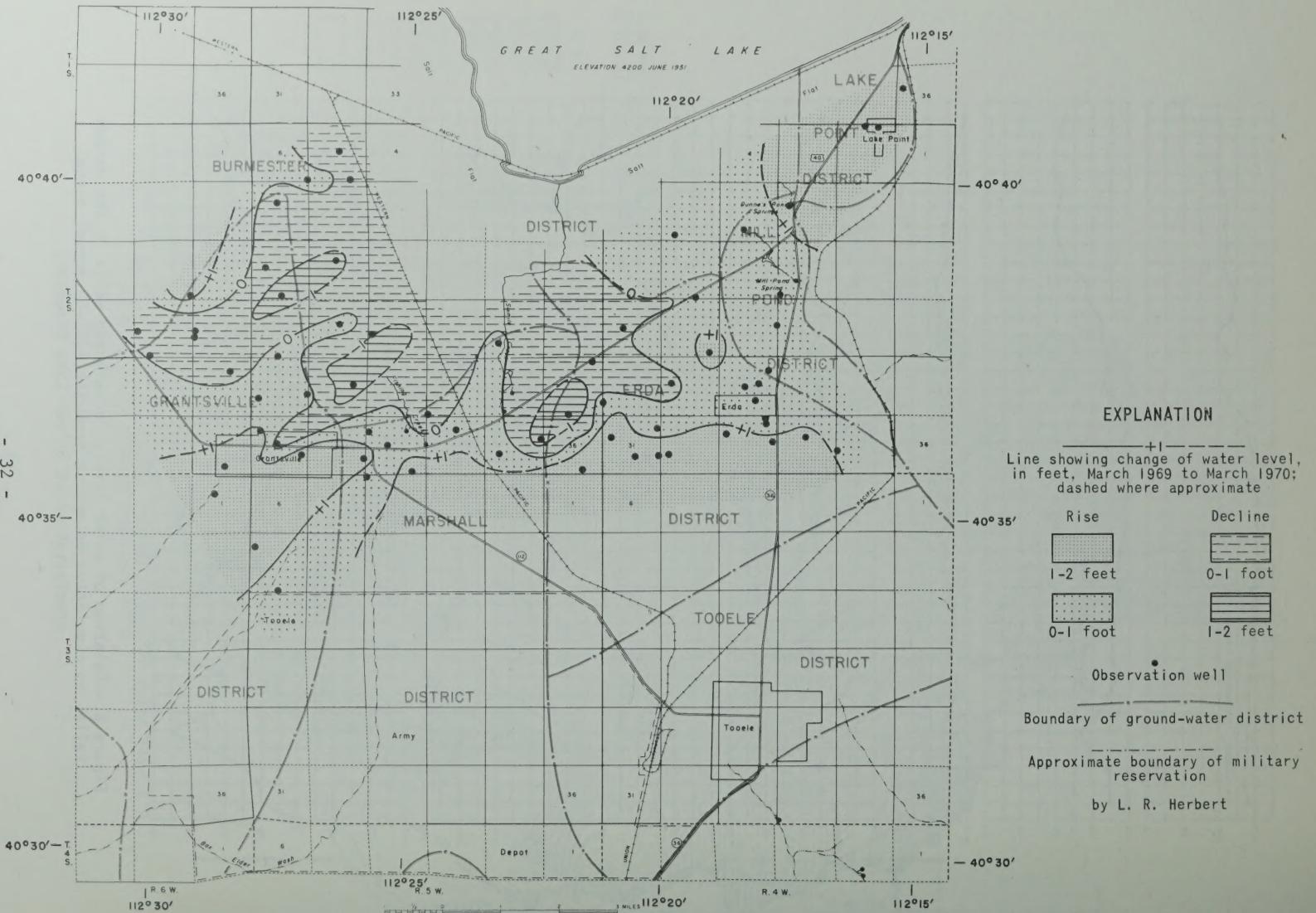


Figure 8.—Relation of water levels in selected wells in the Jordan Valley to cumulative departure from the 1931-60 normal annual precipitation at Silver Lake Brighton.



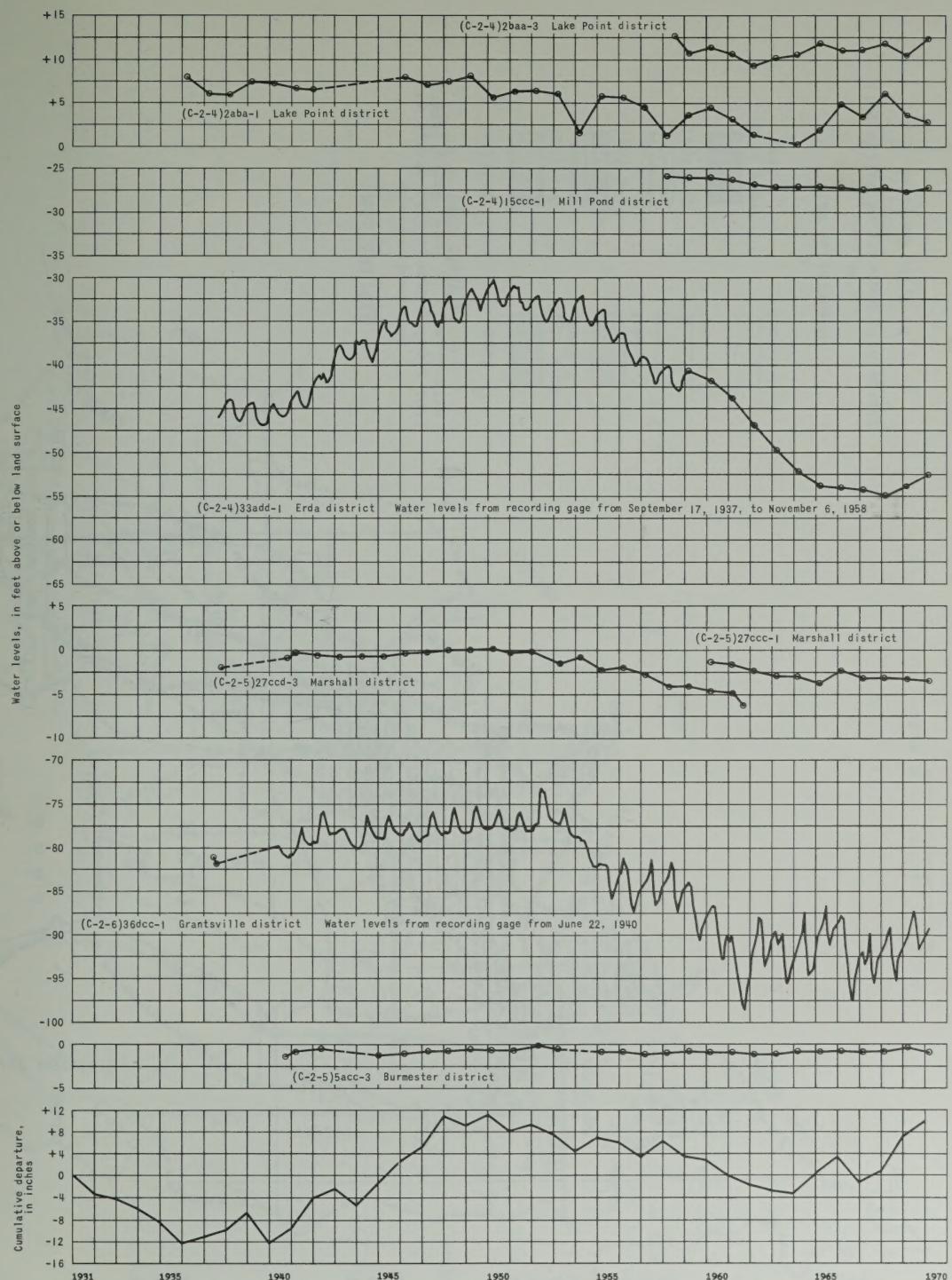
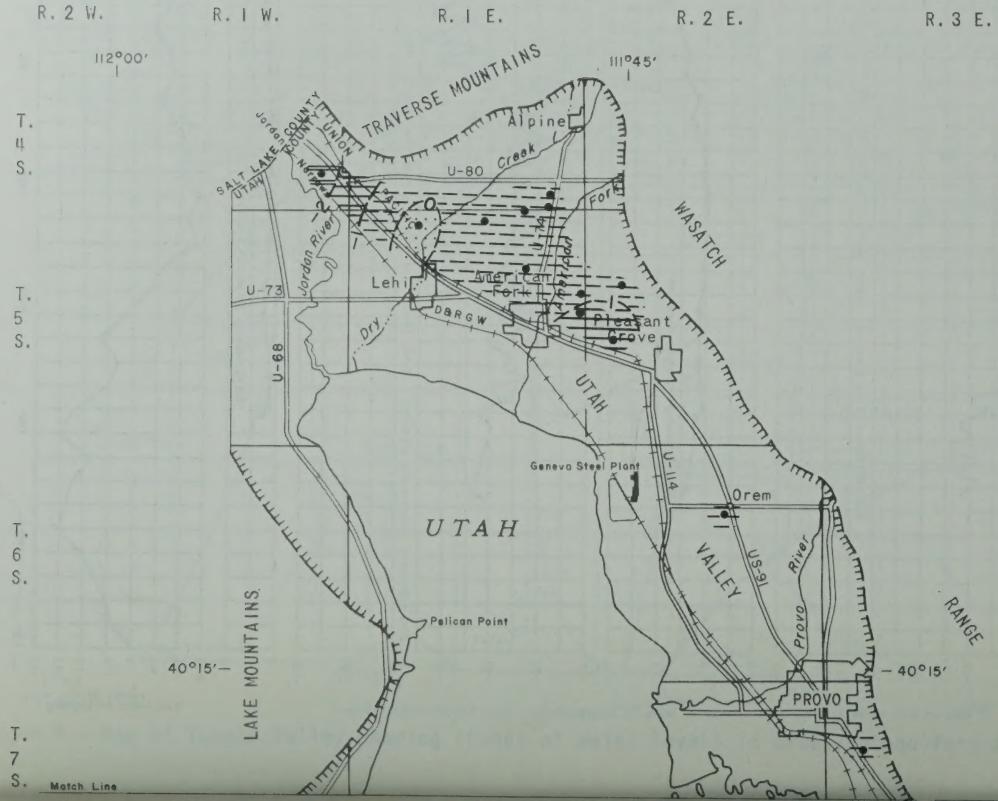


Figure 10.—Relation of water levels in selected wells in Tooele Valley to cumulative departure from the 1931-60 normal annual precipitation at Tooele.

34



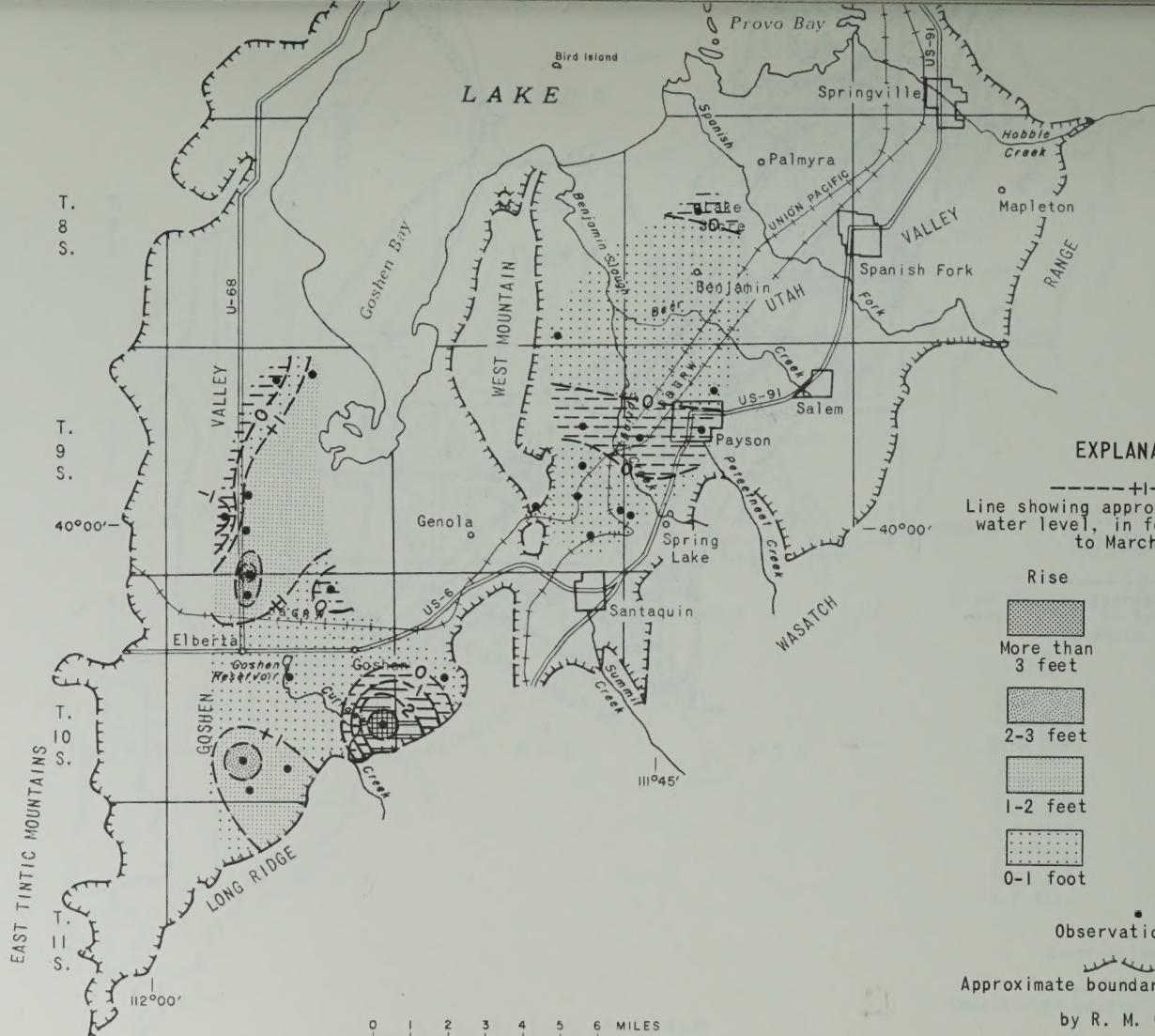


Figure 11.—Map of Utah and Goshen Valleys showing change of water levels in the water-table aquifers from March 1969 to March 1970.

by R. M. Cordova

R. 2 W. R. 1 W. R. 1 E. R. 2 E. R. 3 E.

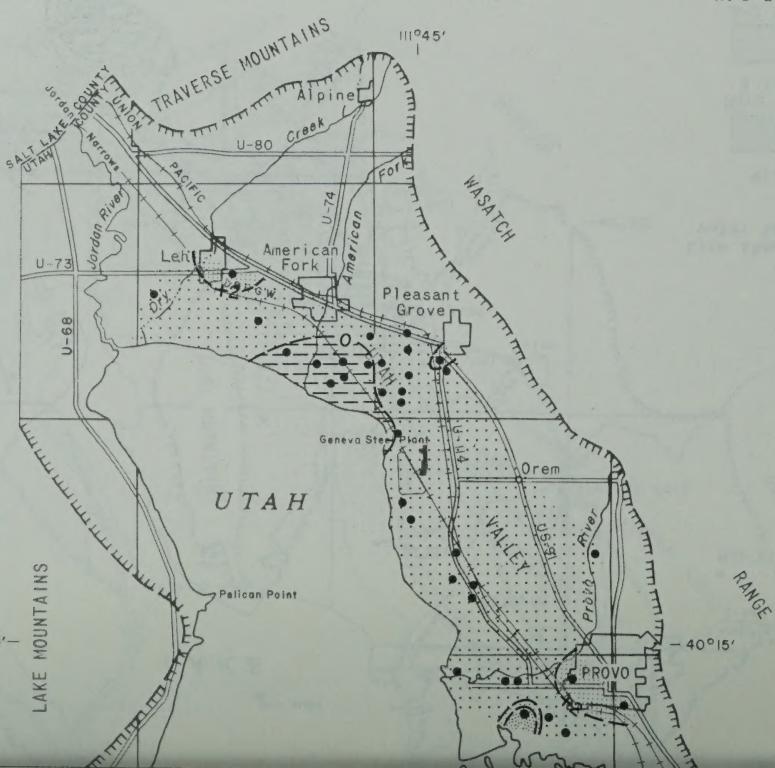
112°00'

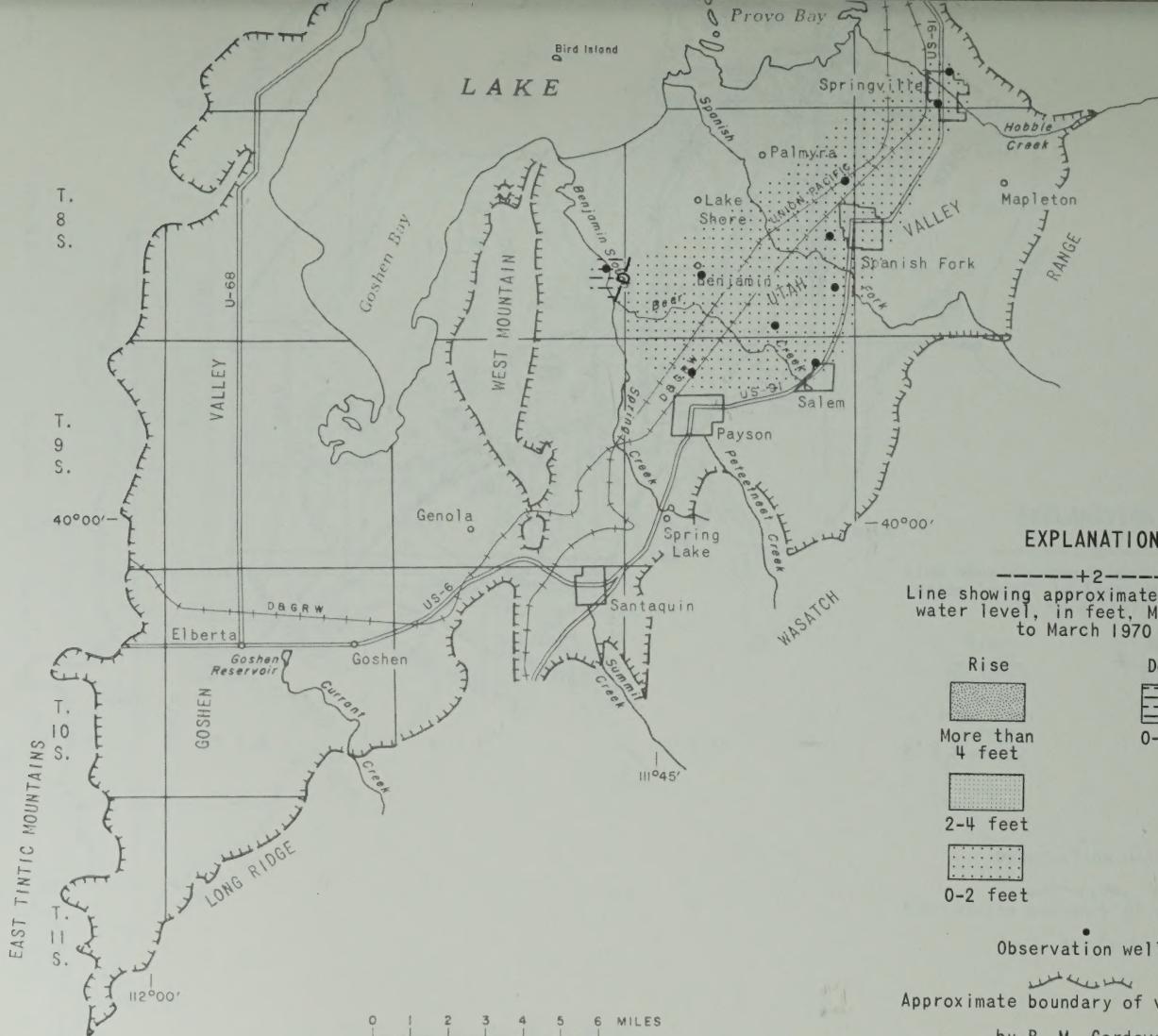
T.
4
S.

T.
5
S.

T.
6
S.

T.
7
S.





EXPLANATION

+2
Line showing approximate change of water level, in feet, March 1969 to March 1970

Rise	Decline
More than 4 feet	0-2 feet
2-4 feet	
0-2 feet	

Observation well

Approximate boundary of valley fill
by R. M. Cordova

Figure 12.—Map of Utah and Goshen Valleys showing change of water levels in the shallow artesian aquifer in rocks of Pleistocene age from March 1969 to March 1970.

R. 2 W.

R. 1 W.

R. 1 E.

R. 2 E.

R. 3 E.

T.
4
S.

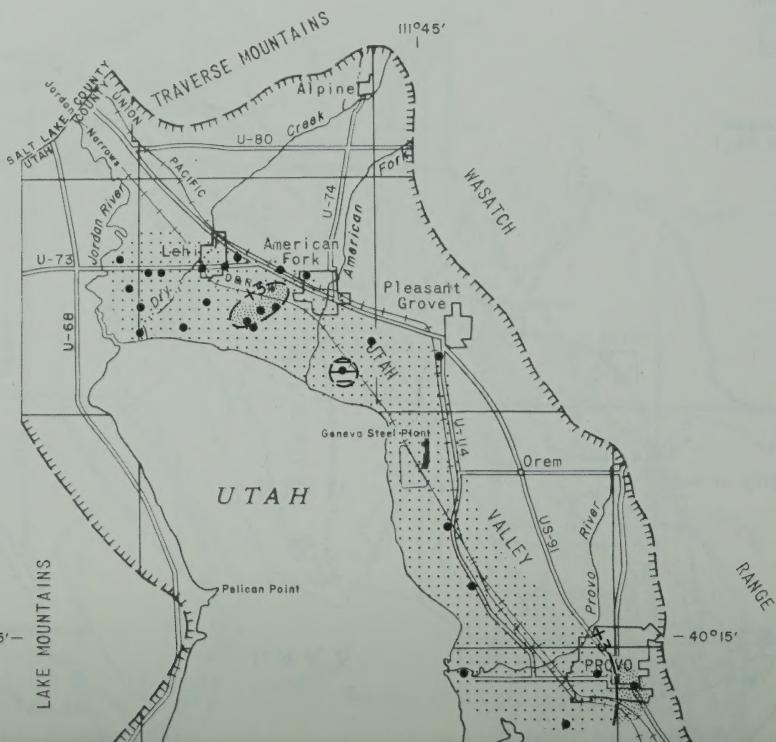
T.
5
S.

T.
6
S.

T.
7

112°00'

111°45'



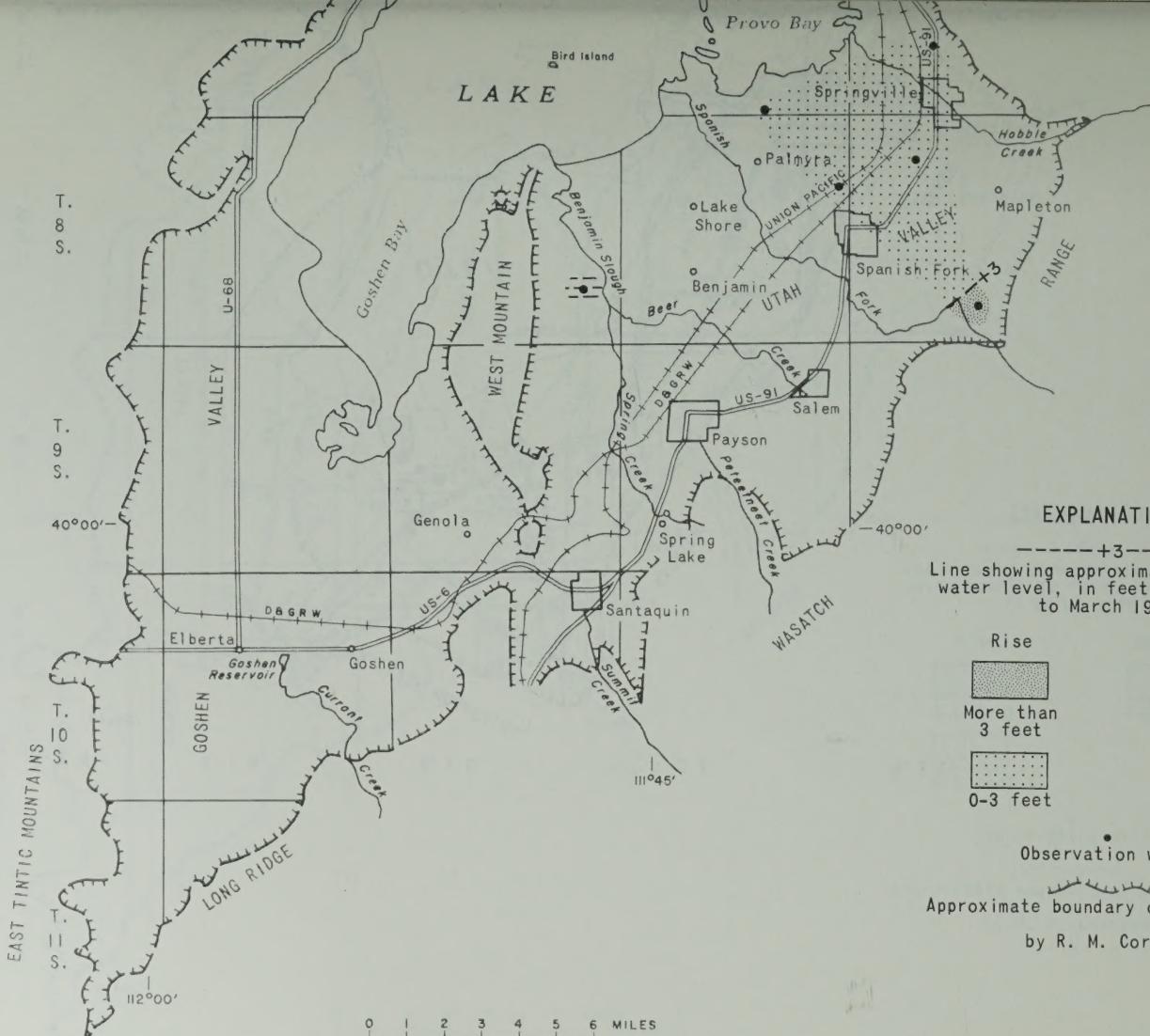
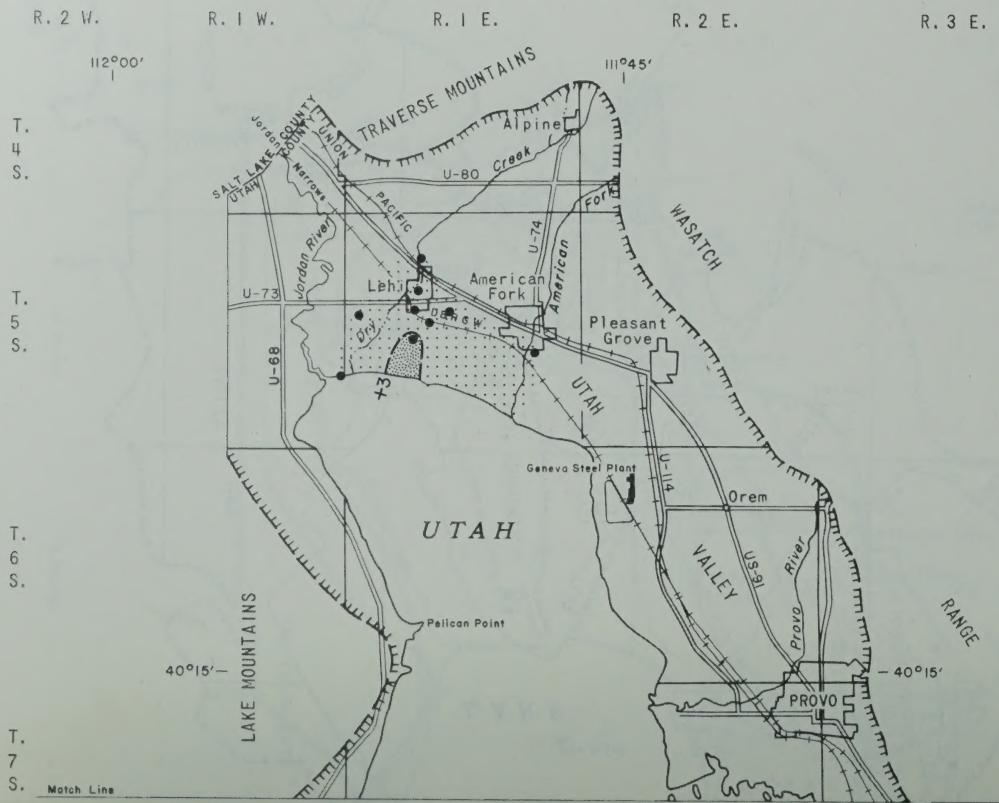


Figure 13.—Map of Utah and Goshen Valleys showing change of water levels in the deep artesian aquifer in rocks of Pleistocene age from March 1969 to March 1970.



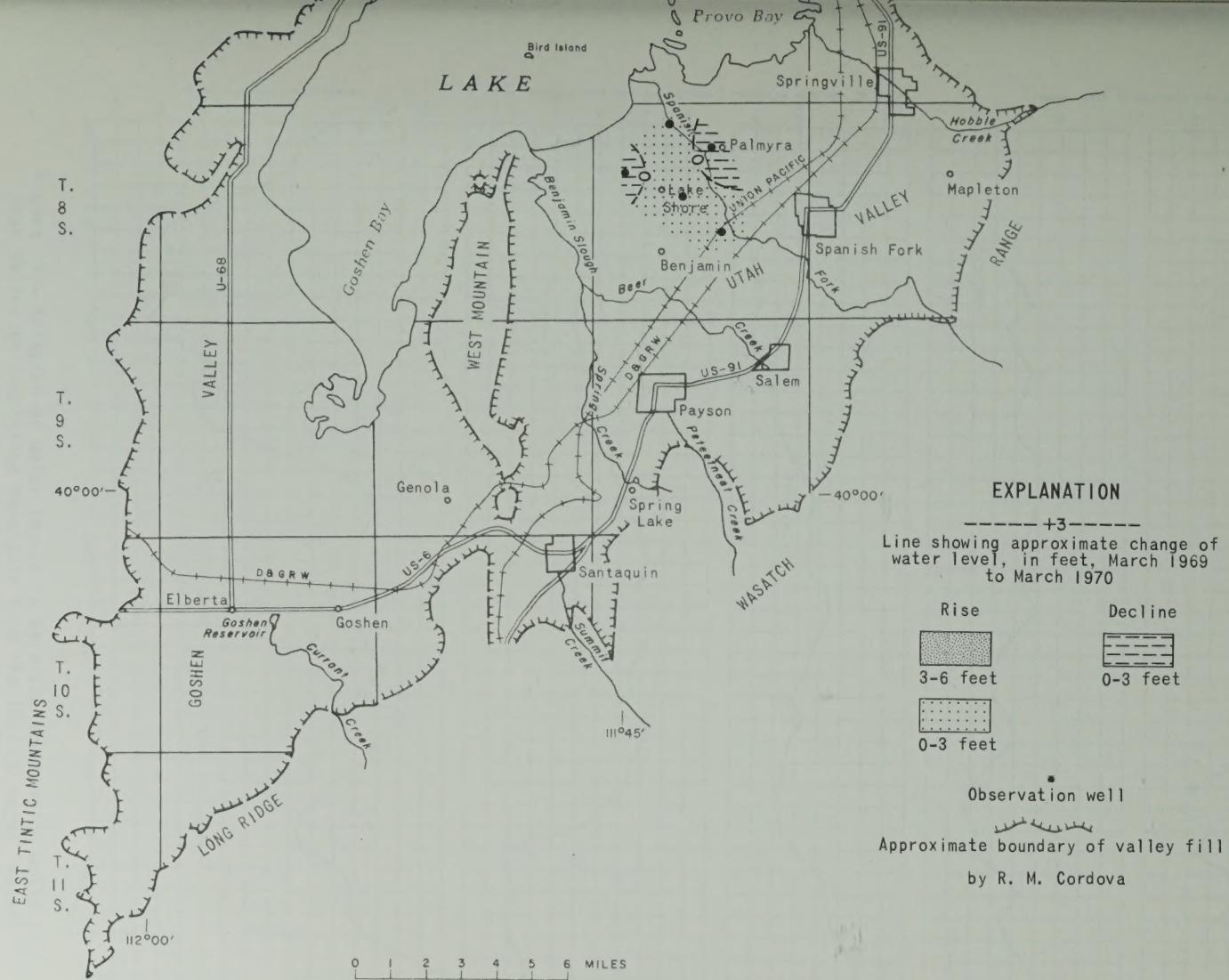


Figure 14.—Map of Utah and Goshen Valleys showing change of water levels in the artesian aquifer in rocks of Tertiary age from March 1969 to March 1970.

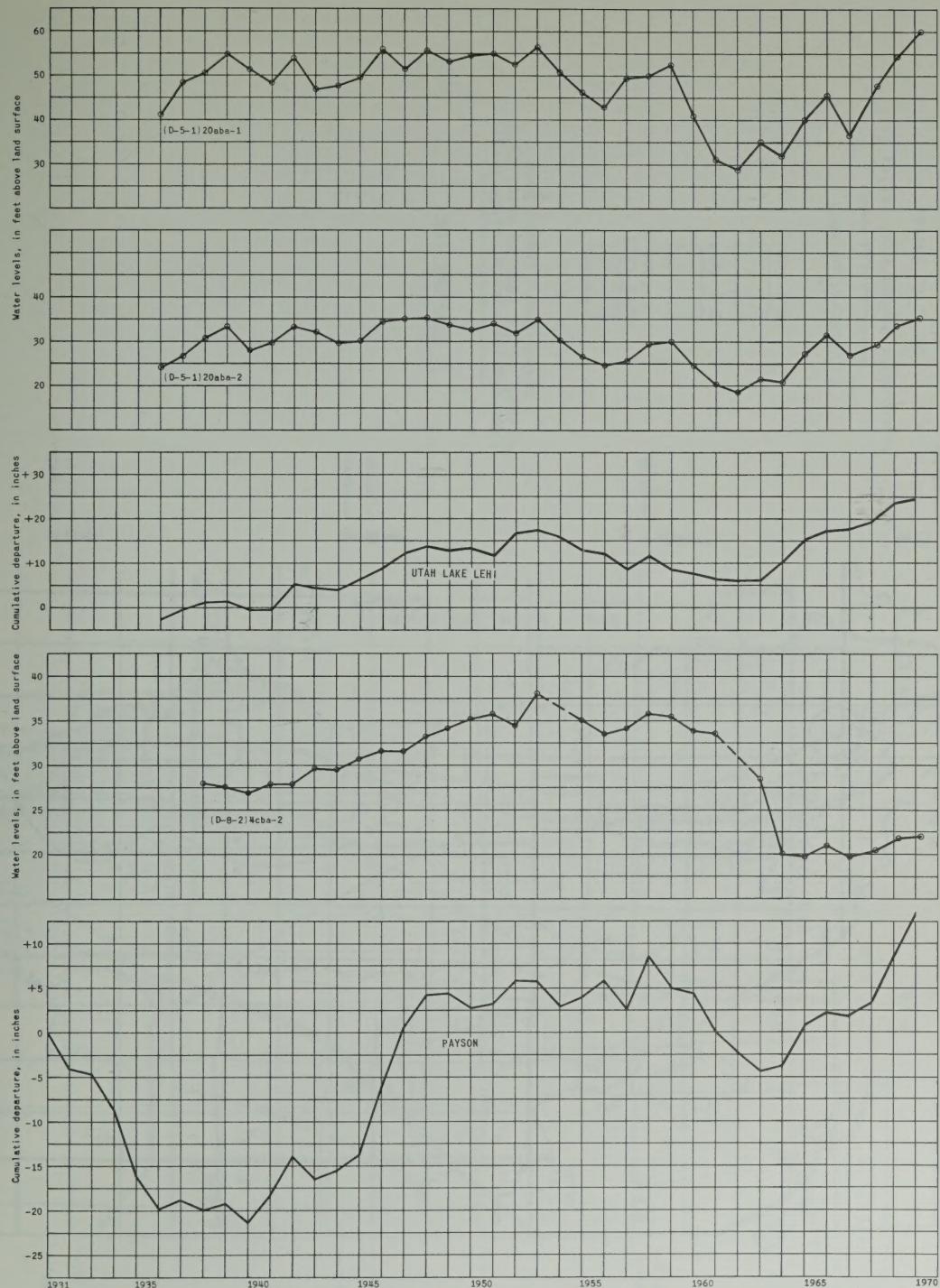
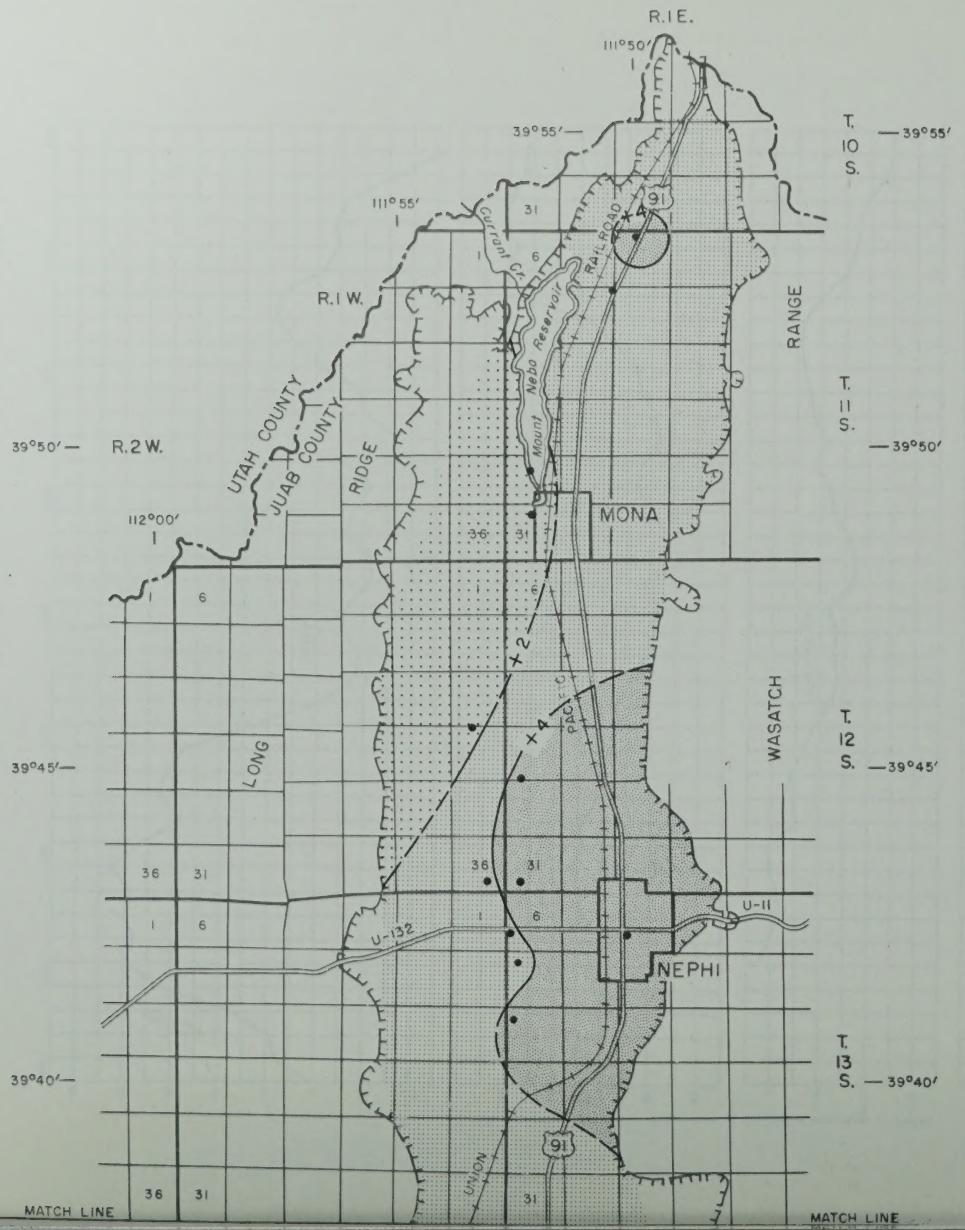
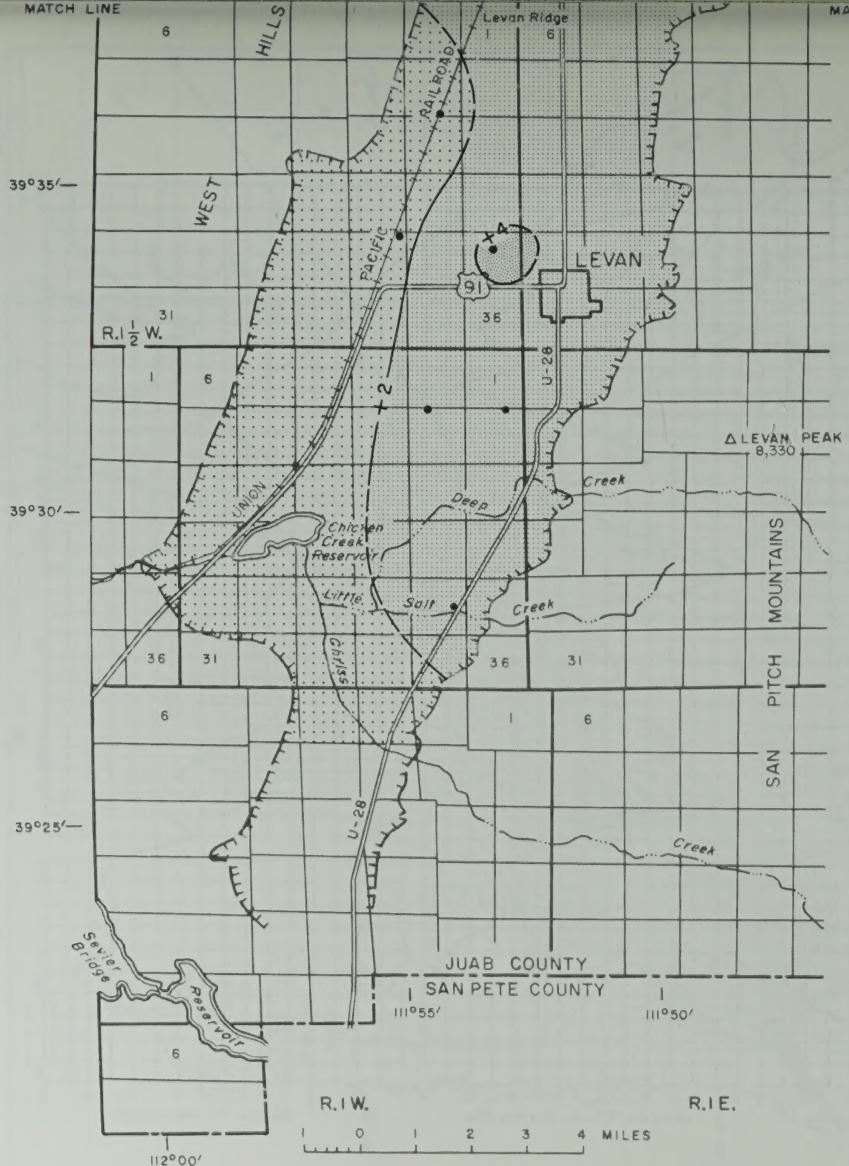


Figure 15.—Relation of water levels in selected observation wells in Utah Valley to cumulative departure from the 1931-60 normal annual precipitation at Utah Lake Lehi and Payson.





T.
14 — 39°35'
S.

T.
15 — 39°30'
S.

EXPLANATION

+2
Line showing rise of water level,
in feet, March 1969 to March 1970;
dashed where approximate

Rise

More than 4 feet

2-4 feet

0-2 feet

T. — 39°25'
16
S.

Observation well

Approximate boundary of valley fill
by R. G. Butler

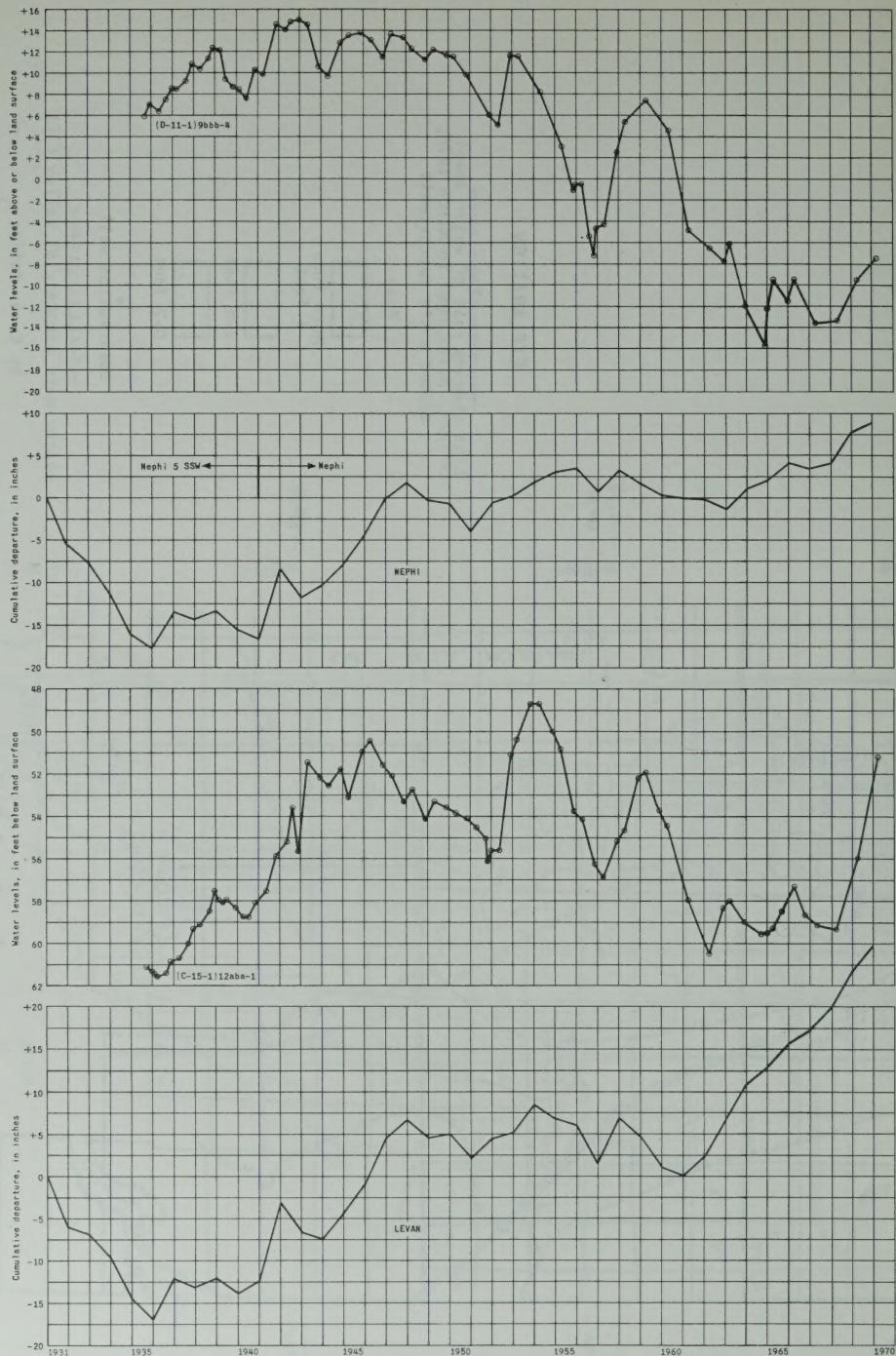


Figure 17.—Relation of water levels in wells (D-11-1)9bbb-4 and (C-15-1)12aba-1 to cumulative departure from the 1931-60 normal annual precipitation at Nephi and Levan.

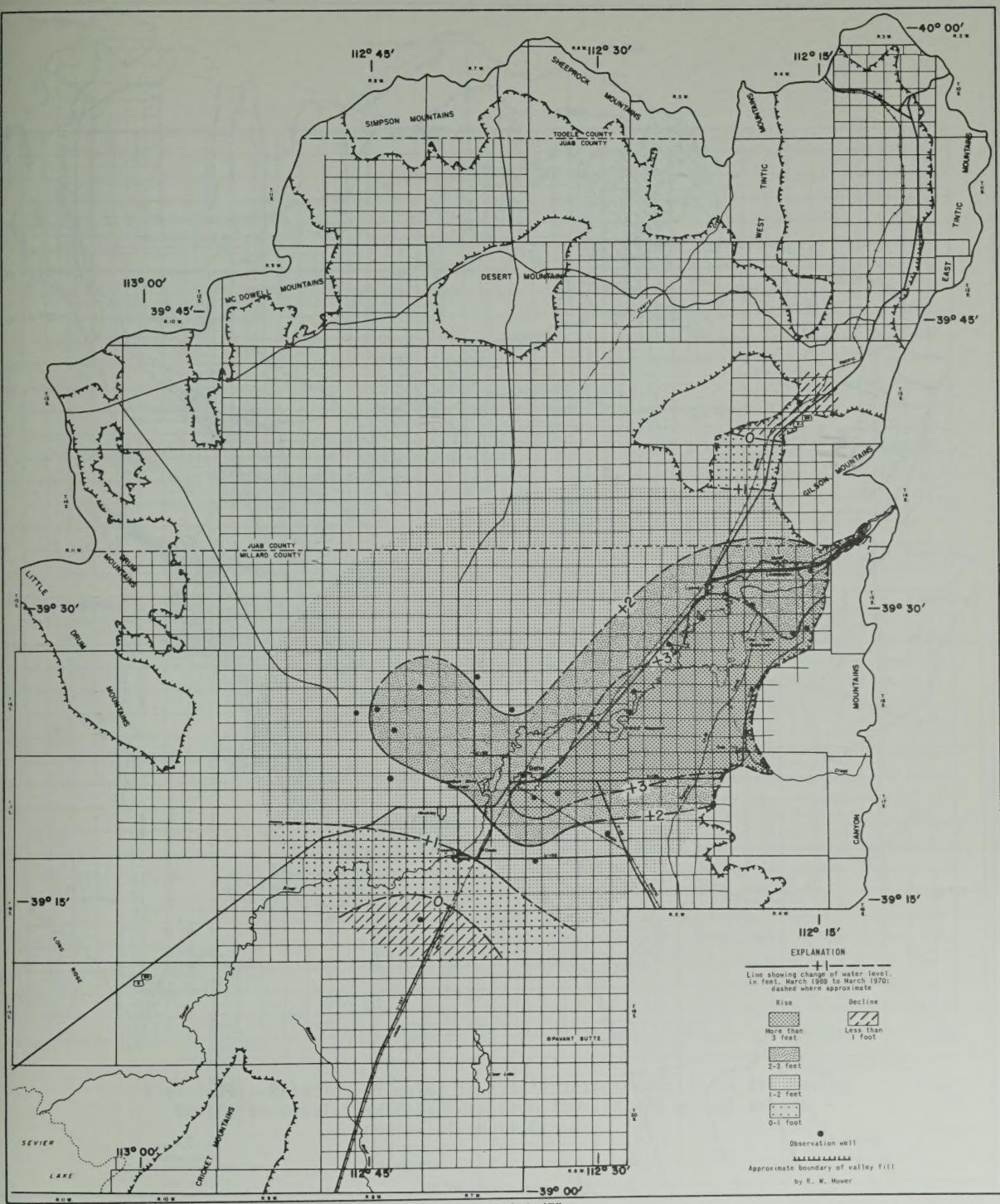


Figure 18.—Map of part of the Sevier Desert showing change of water levels in the lower artesian aquifer from March 1969 to March 1970.

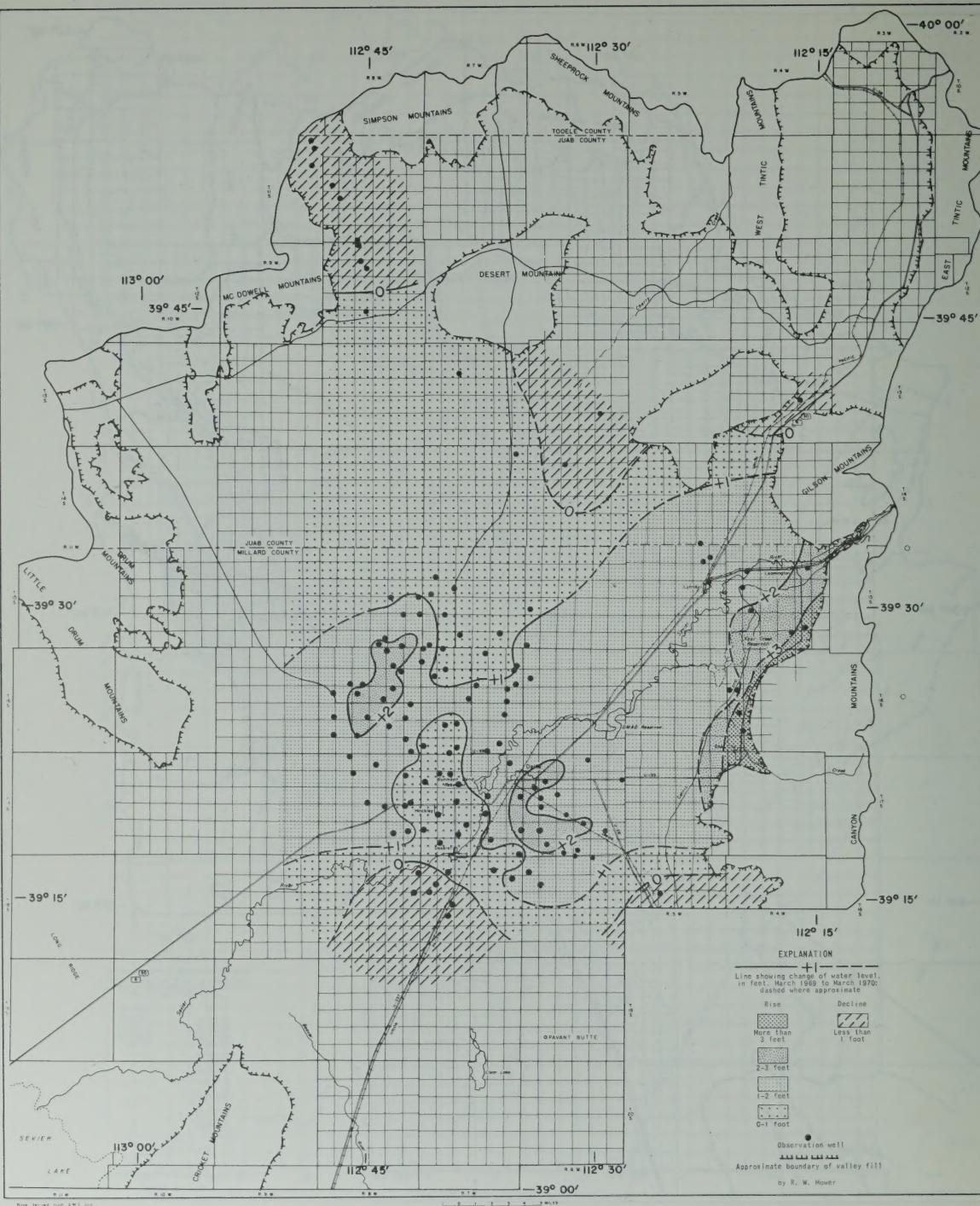


Figure 19.—Map of part of the Sevier Desert showing change of water levels in the upper artesian aquifer from March 1969 to March 1970.

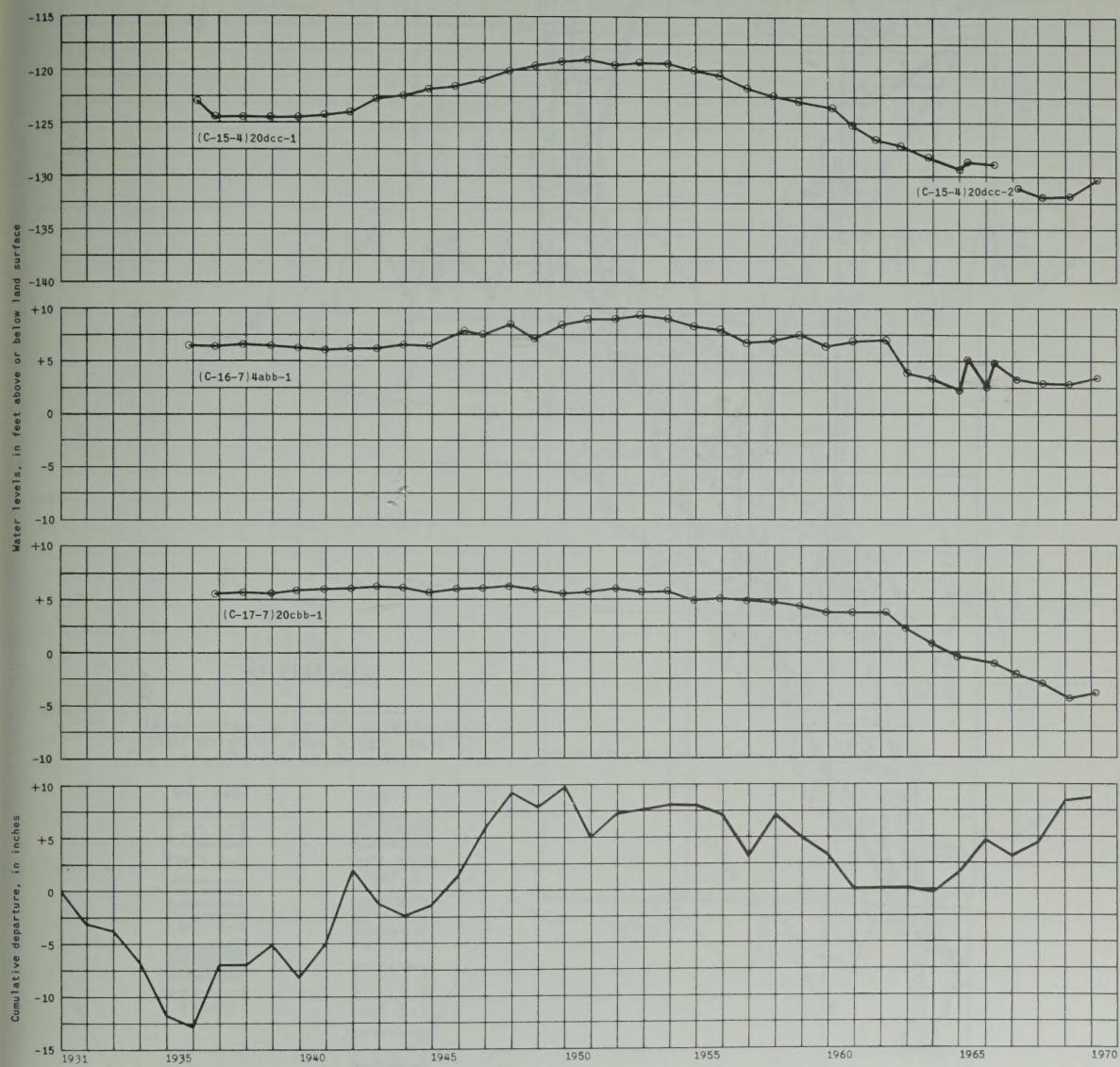
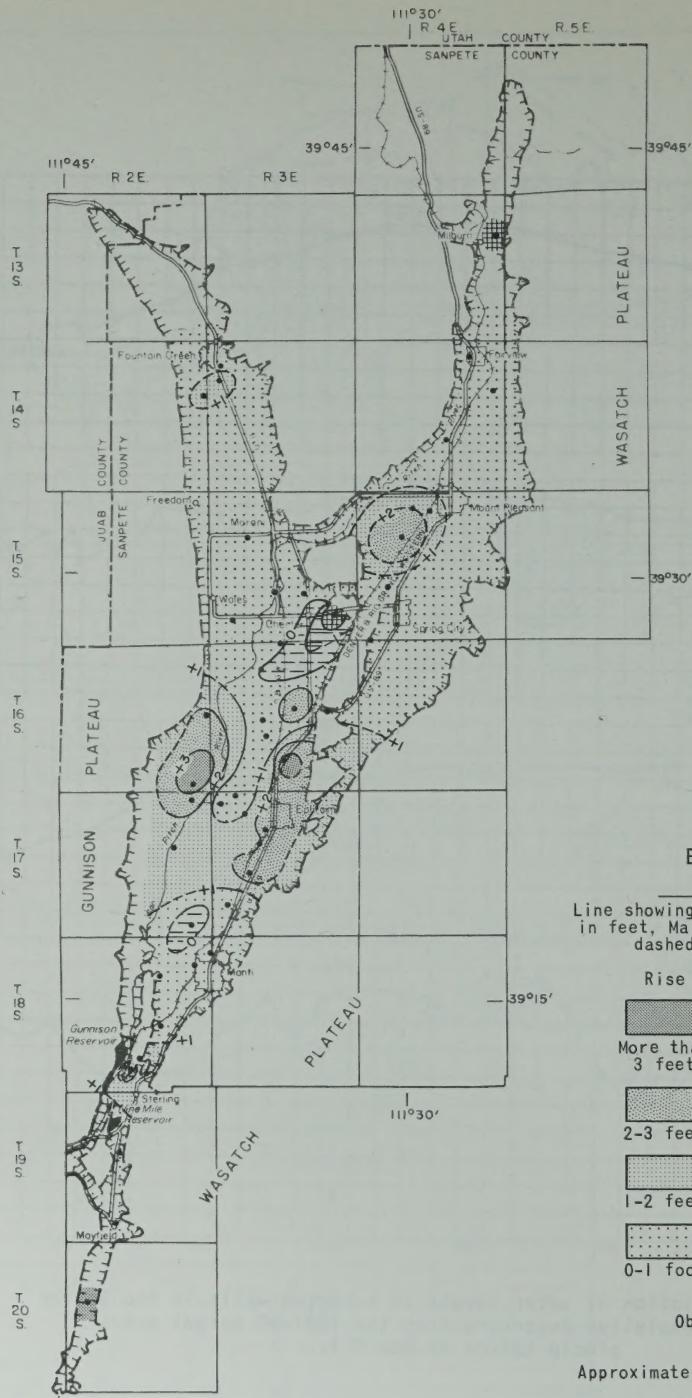


Figure 20.—Relation of water levels in selected wells in the Sevier Desert to cumulative departure from the 1931-60 normal annual precipitation at Oak City.



EXPLANATION

Line showing change of water level,
in feet, March 1969 to March 1970;
dashed where approximate

Rise	Decline
More than 3 feet	0-1 foot
2-3 feet	1-2 feet
1-2 feet	More than 2 feet
0-1 foot	

Observation well

Approximate boundary of valley fill

by R. G. Butler

Base derived from A.M.S. maps

0 1 2 3 4 5 MILES

Figure 21.—Map of Sanpete Valley showing change of water levels from March 1969 to March 1970.

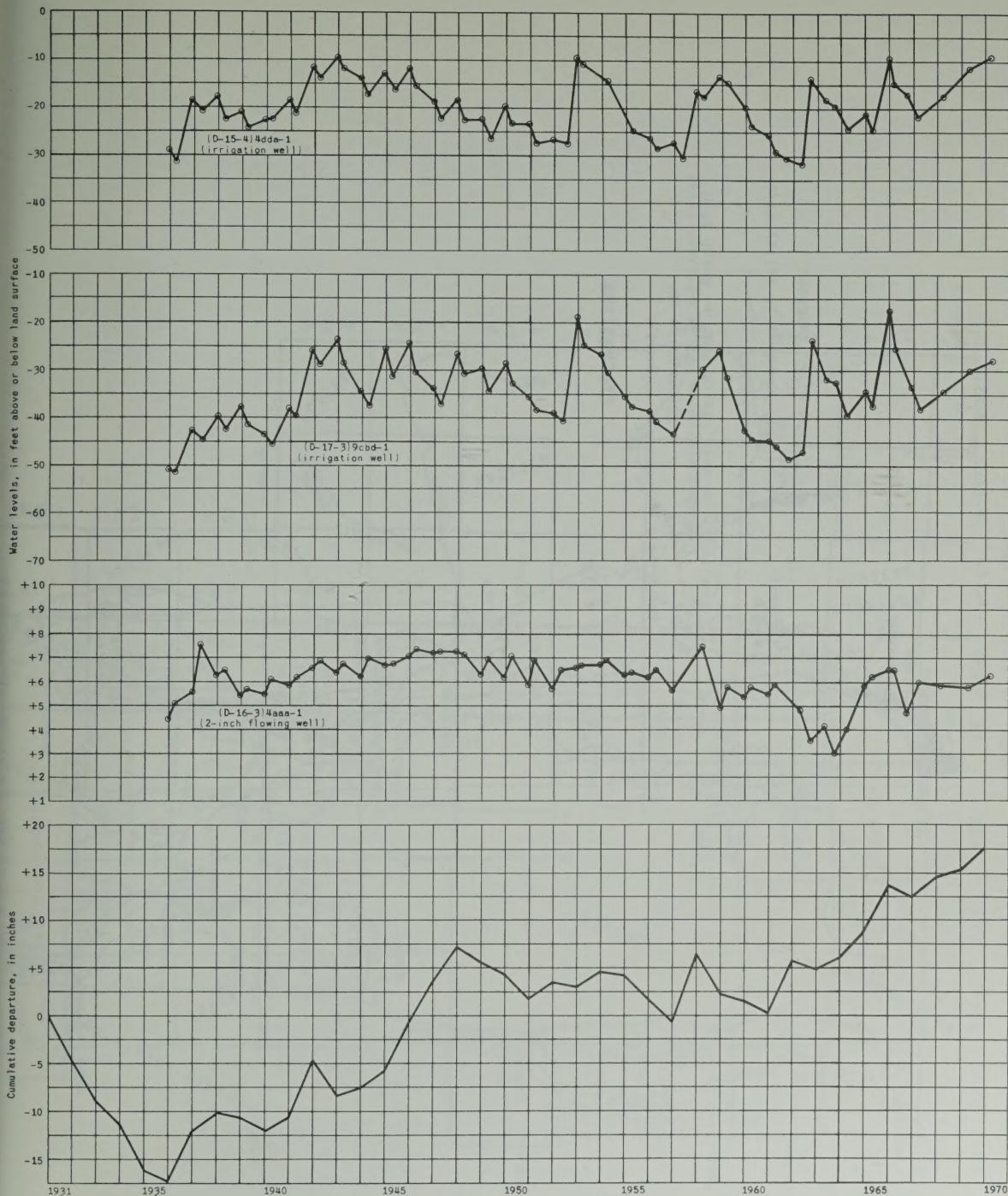
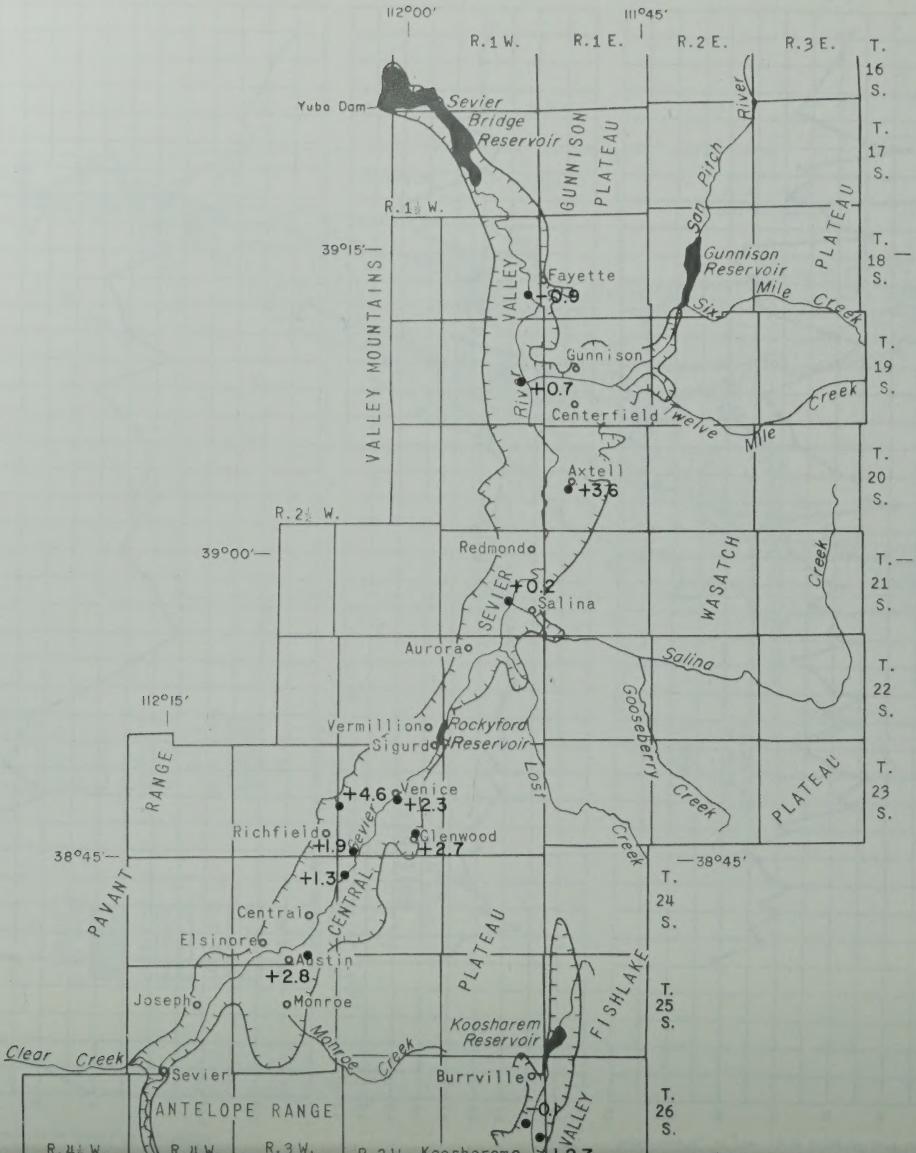
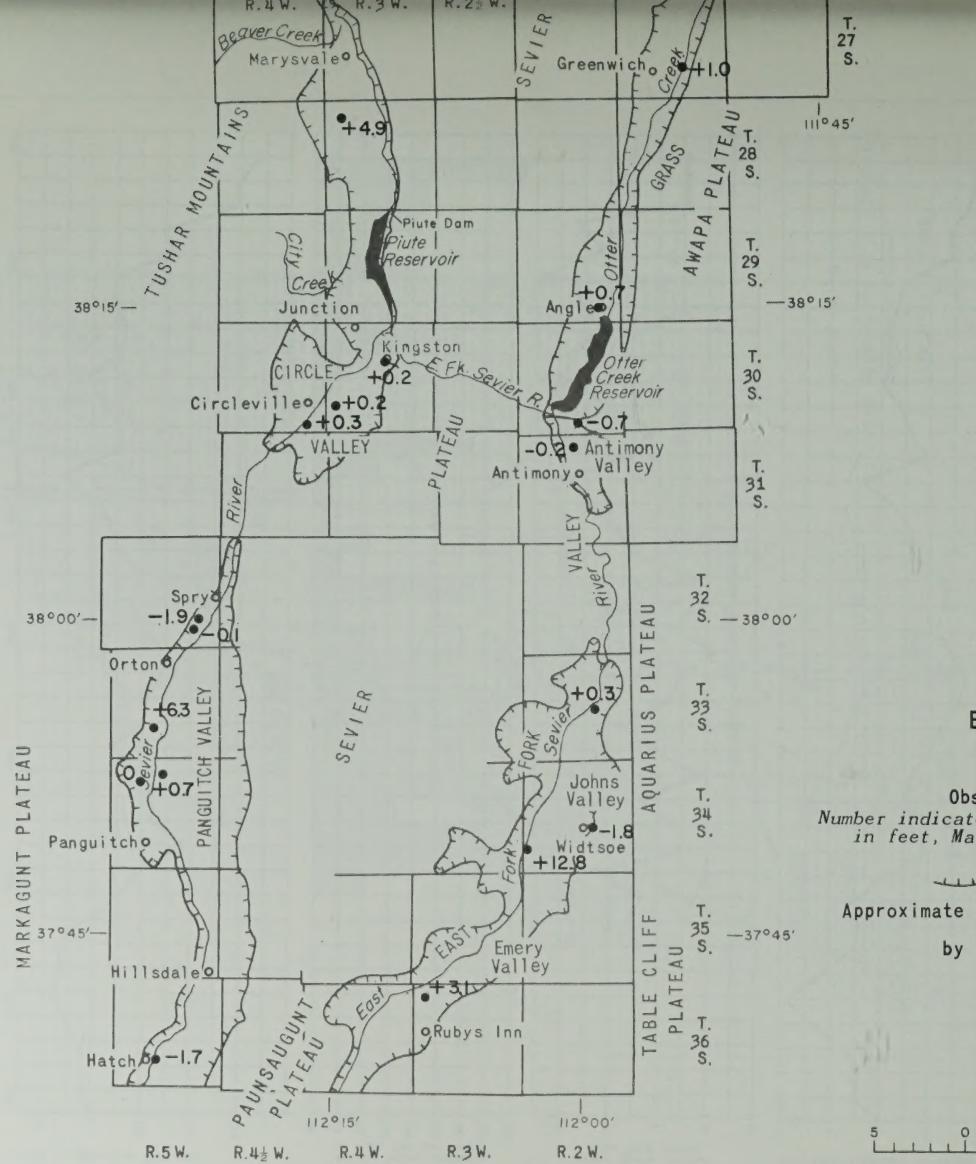


Figure 22.—Relation of water levels in three wells in Sanpete Valley to cumulative departure from the 1931-60 normal annual precipitation at Manti.





EXPLANATION

• +4.6

Observation well

Number indicates change of water level,
in feet, March 1969 to March 1970

Approximate boundary of valley fill

by G. W. Sandberg

Figure 23.—Map of the upper and central Sevier Valleys showing change of water levels from March 1969 to March 1970.

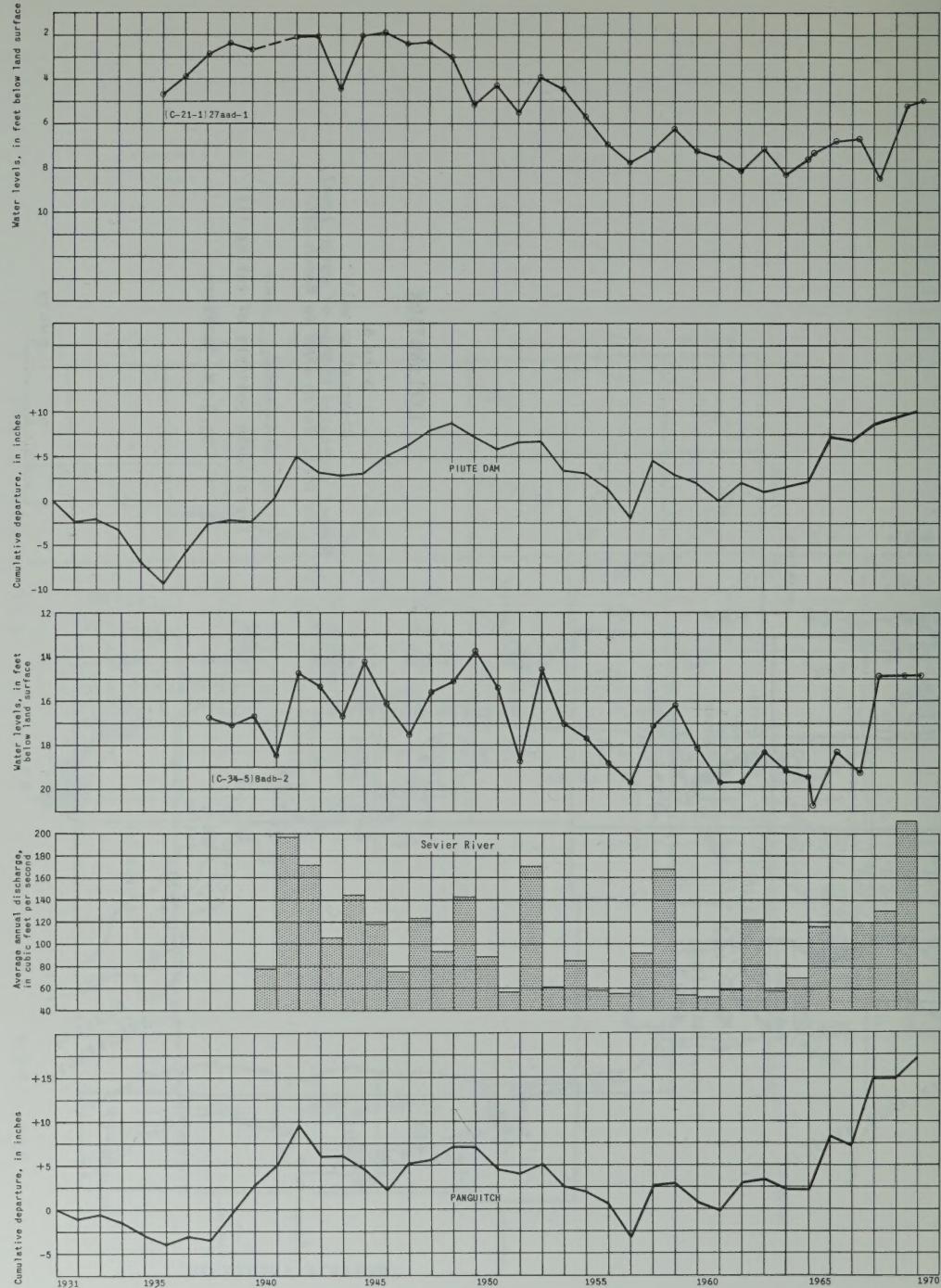


Figure 24.—Relation of water levels in selected observation wells and of average annual discharge of the Sevier River at Hatch to cumulative departure from the 1931-60 normal annual precipitation at Piute Dam and Panguitch.

EXPLANATION

+2

Line showing change of water level,
in feet, March 1969 to March 1970;
dashed where approximate

Rise



More than
6 feet



4-6 feet



2-4 feet



0-2 feet

Decline



0-2 feet



More than
2 feet

Observation well

Boundary of ground-water district T20S
by R. W. Mower

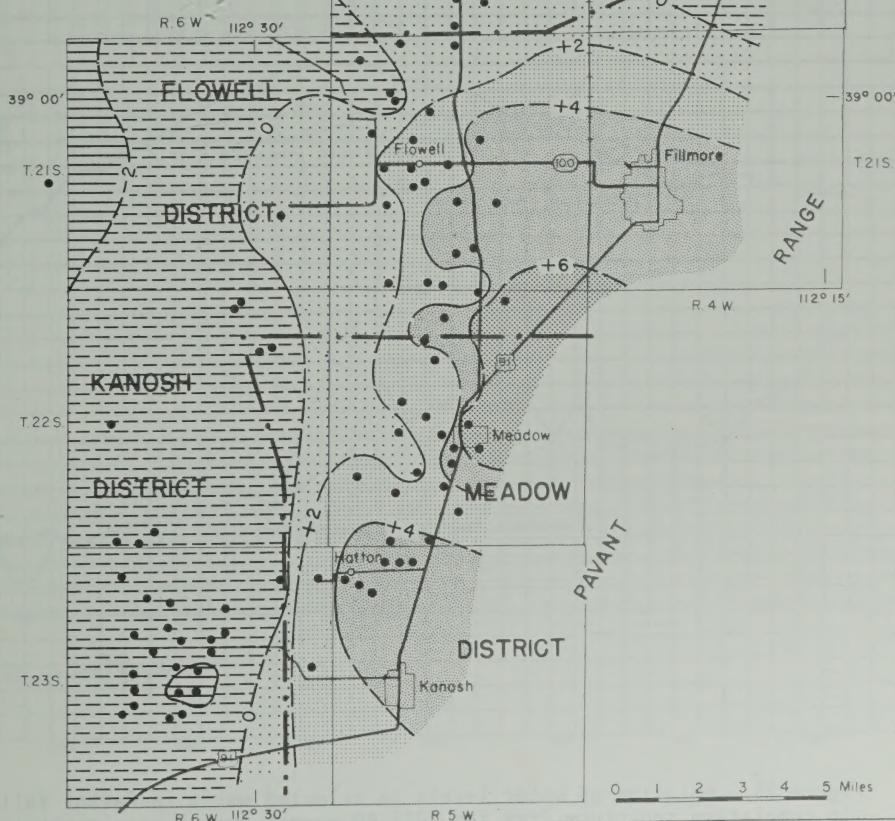


Figure 25. - Map of the Pavant Valley showing change of water levels from March 1969 to March 1970.

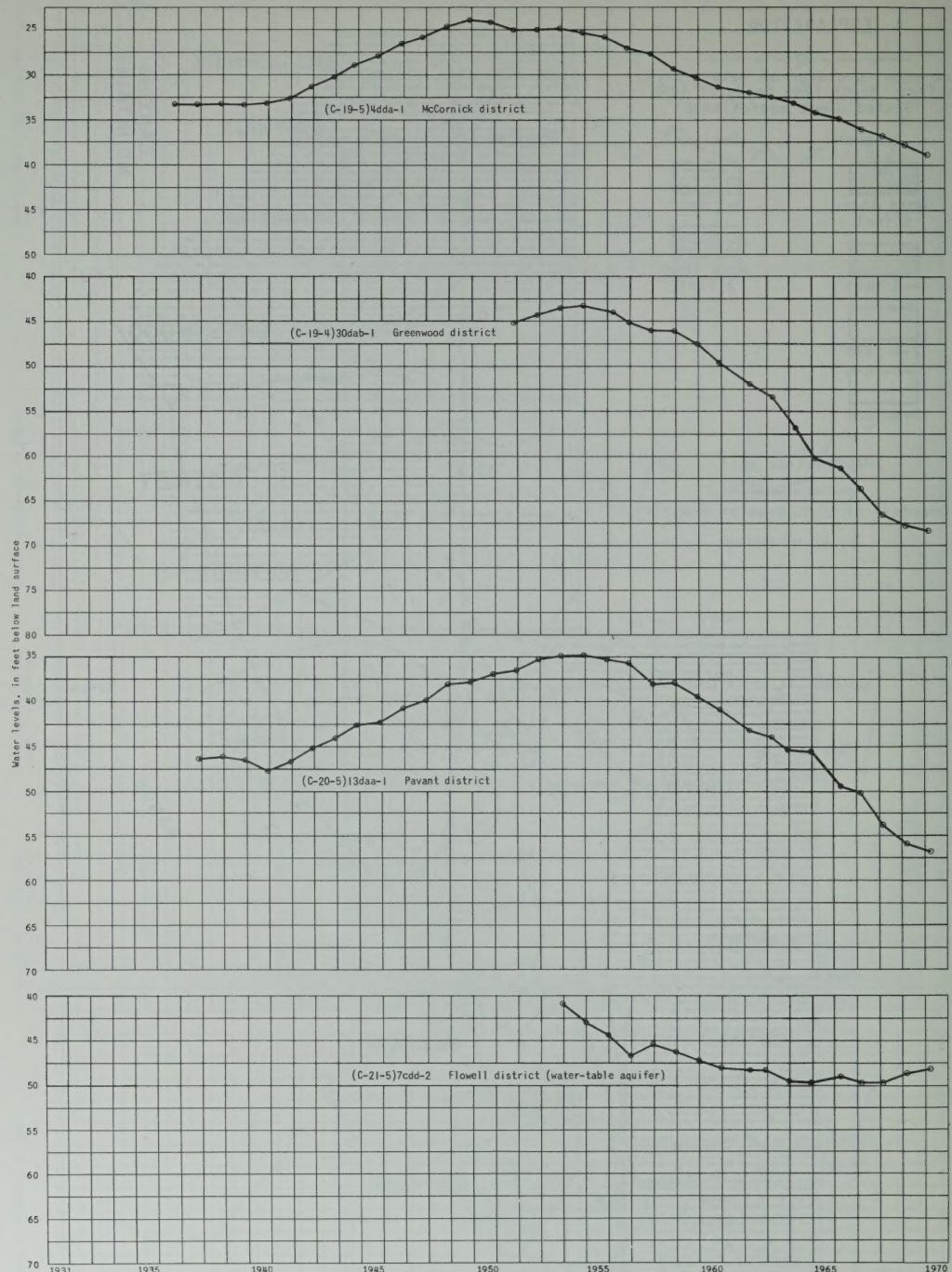


Figure 26.—Relation of water levels in selected wells in Pavant Valley to cumulative departure from the 1931-60 normal annual precipitation at Fillmore.

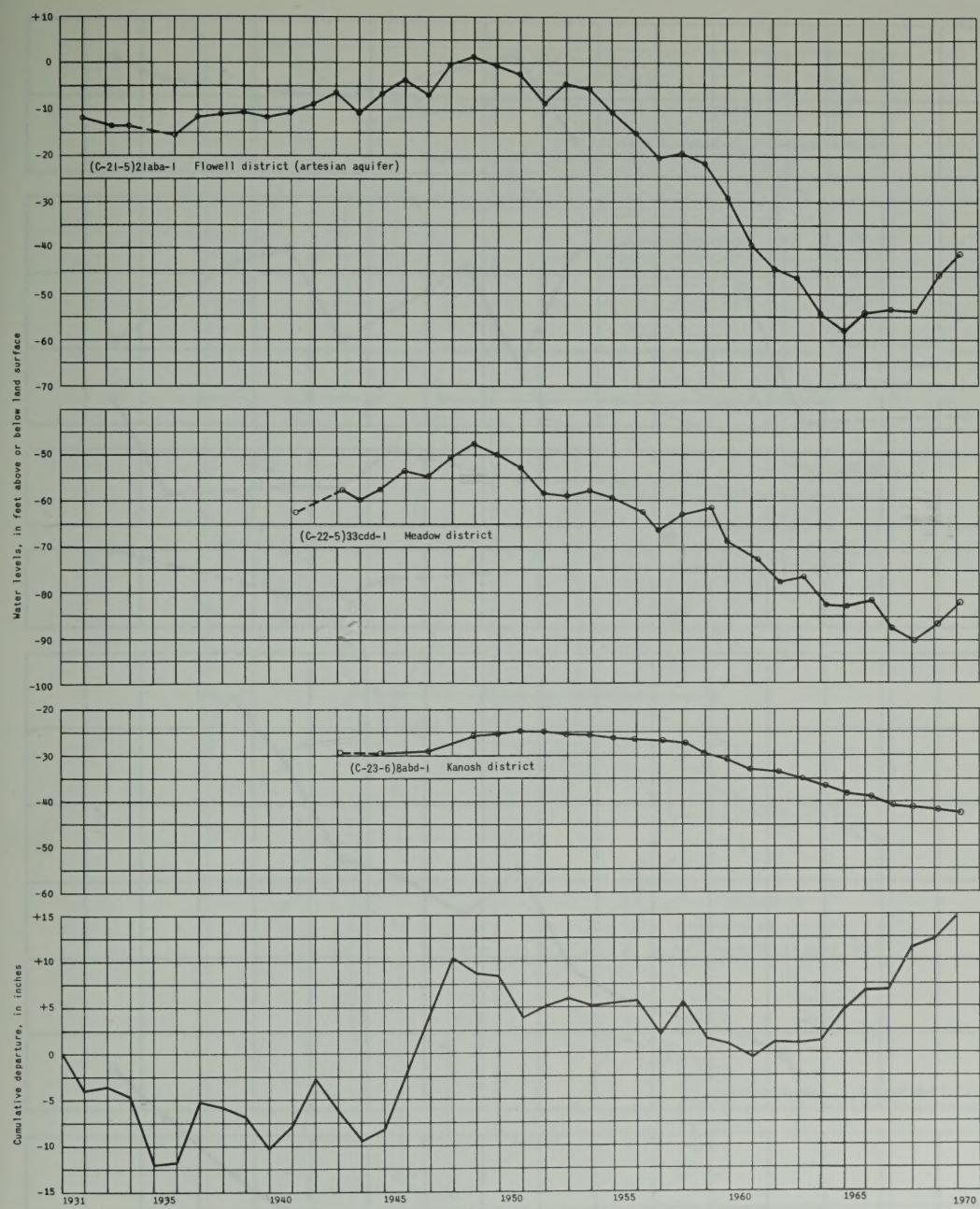


Figure 26.—Continued.

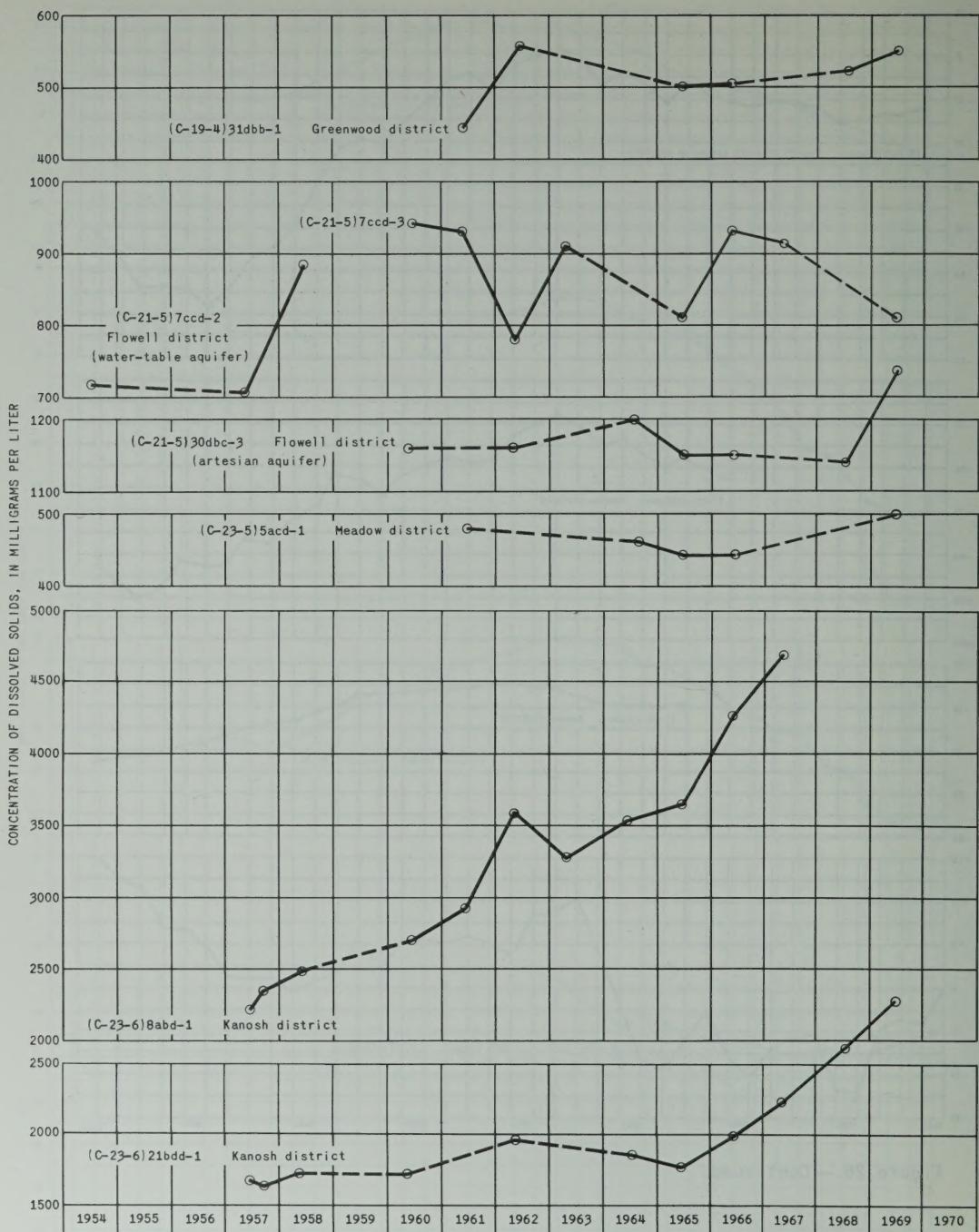


Figure 27.—Concentration of dissolved solids in water from selected wells in Pavant Valley. (Concentrations calculated from determined constituents, except those for 1962 which were calculated from residue on evaporation at 180° C).

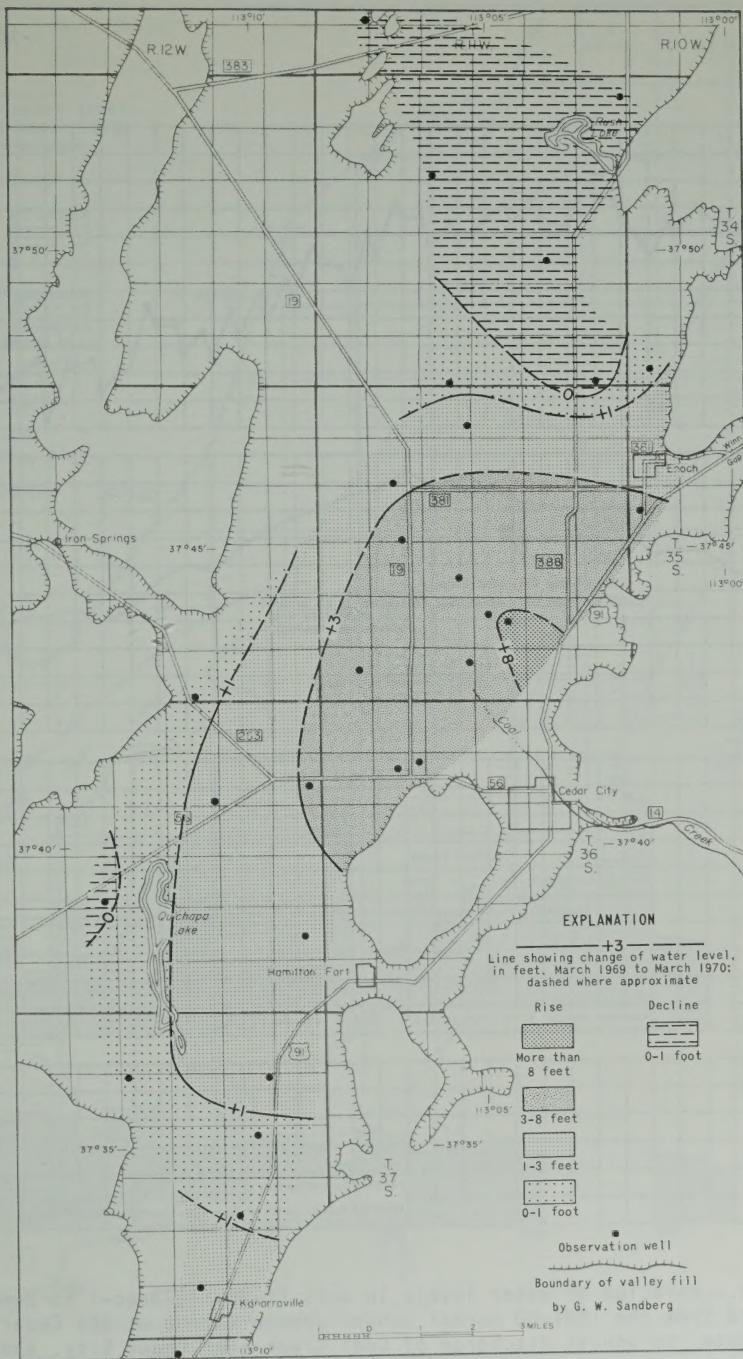


Figure 28.—Map of Cedar City Valley showing change of water levels from March 1969 to March 1970.

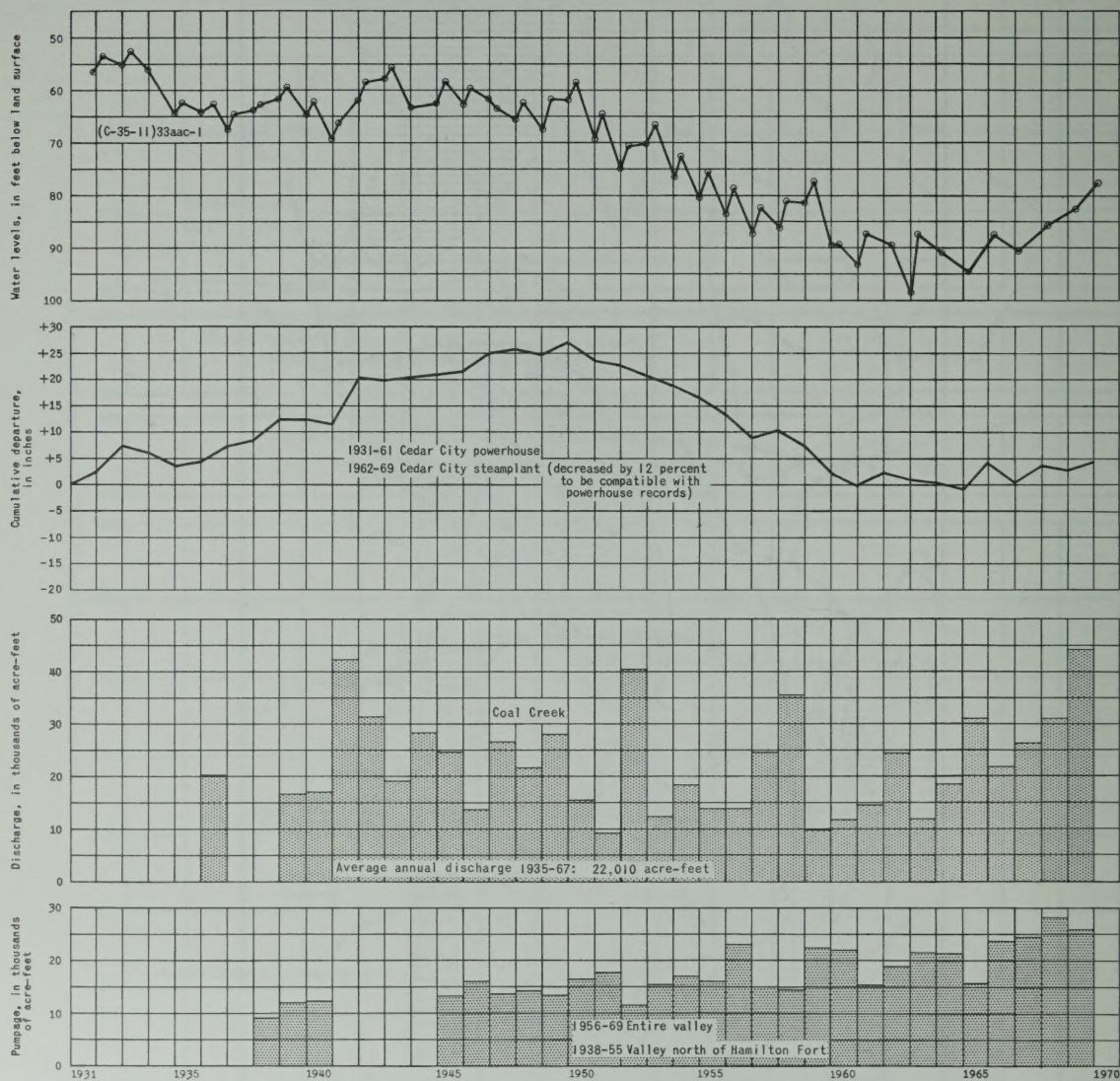


Figure 29.—Relation of water levels in well (C-35-11)33aac-1 to cumulative departure from the 1931-60 normal annual precipitation at the Cedar City powerhouse, to annual discharge of Coal Creek near Cedar City, and to annual pumpage for irrigation in Cedar City Valley.

EXPLANATION

+ Line showing change of water level,
in feet, March 1969 to March 1970;
dashed where approximate

Rise	Decline
More than 1 foot	Dashed
0-1 foot	Horizontal lines

Observation well

Boundary of valley fill

by G. W. Sandberg

R.9 W.

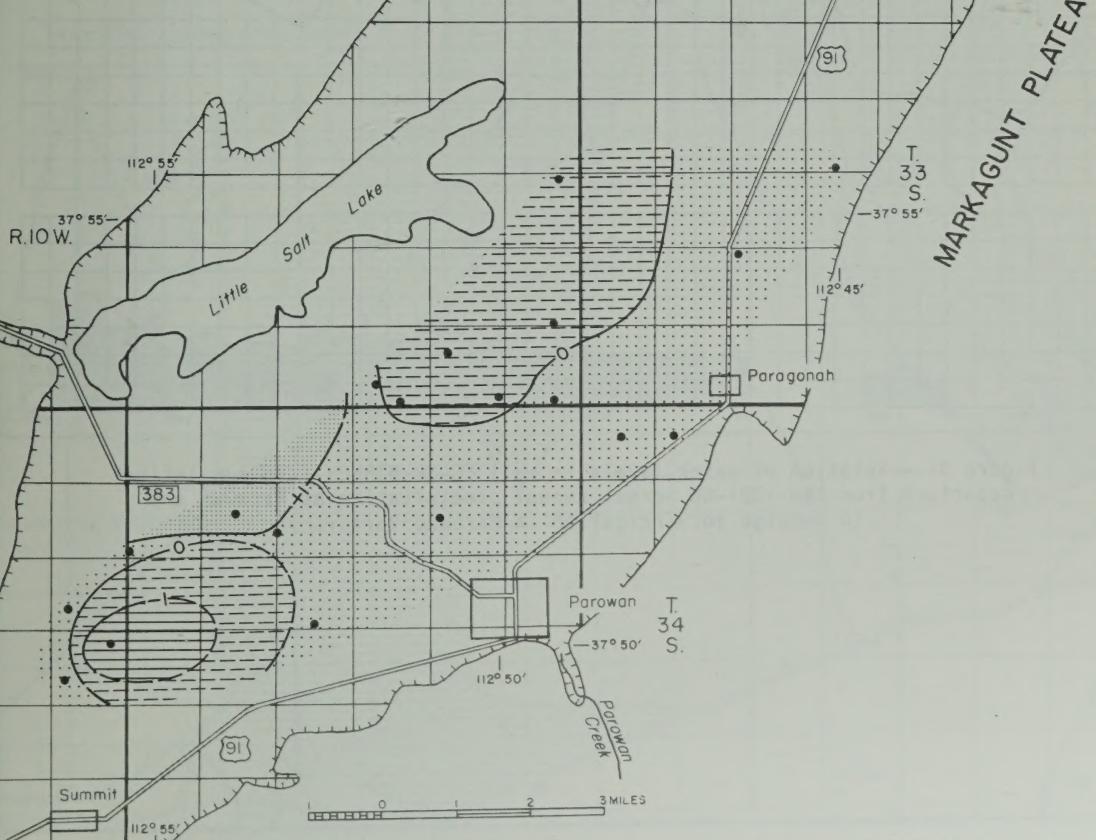


Figure 30.—Map of Parowan Valley showing change of water levels
from March 1969 to March 1970.

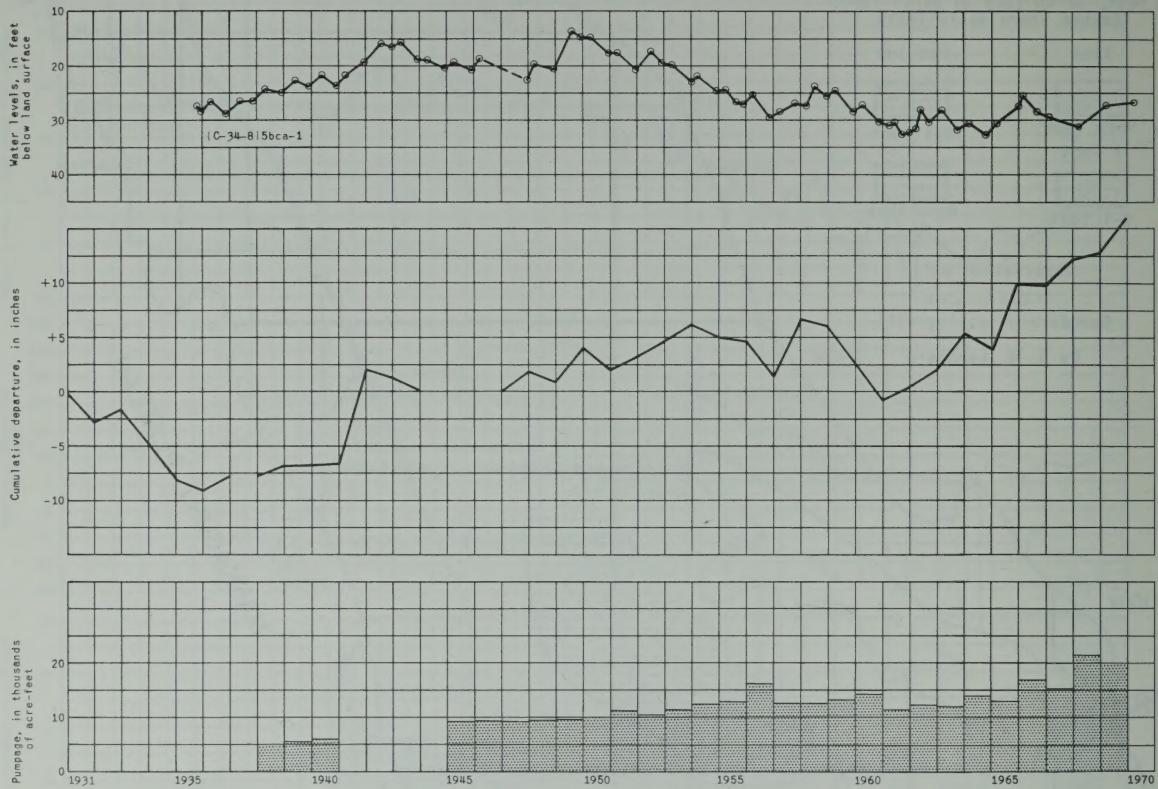


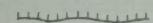
Figure 31.—Relation of water levels in well (C-34-8)5bca-1 to cumulative departure from the 1931-60 normal annual precipitation at Parowan and to pumpage for irrigation in Parowan Valley.

EXPLANATION

+5
Line showing change of water level,
in feet, March 1969 to March 1970;
dashed where approximate

Rise	Decline
[Dotted pattern]	[Dashed pattern]
More than 9 feet	0-1 foot
5-9 feet	1-3 feet
2-5 feet	More than 3 feet
0-2 feet	

Observation well



Boundary of valley fill

by G. W. Sandberg

0 1 2 3 MILES

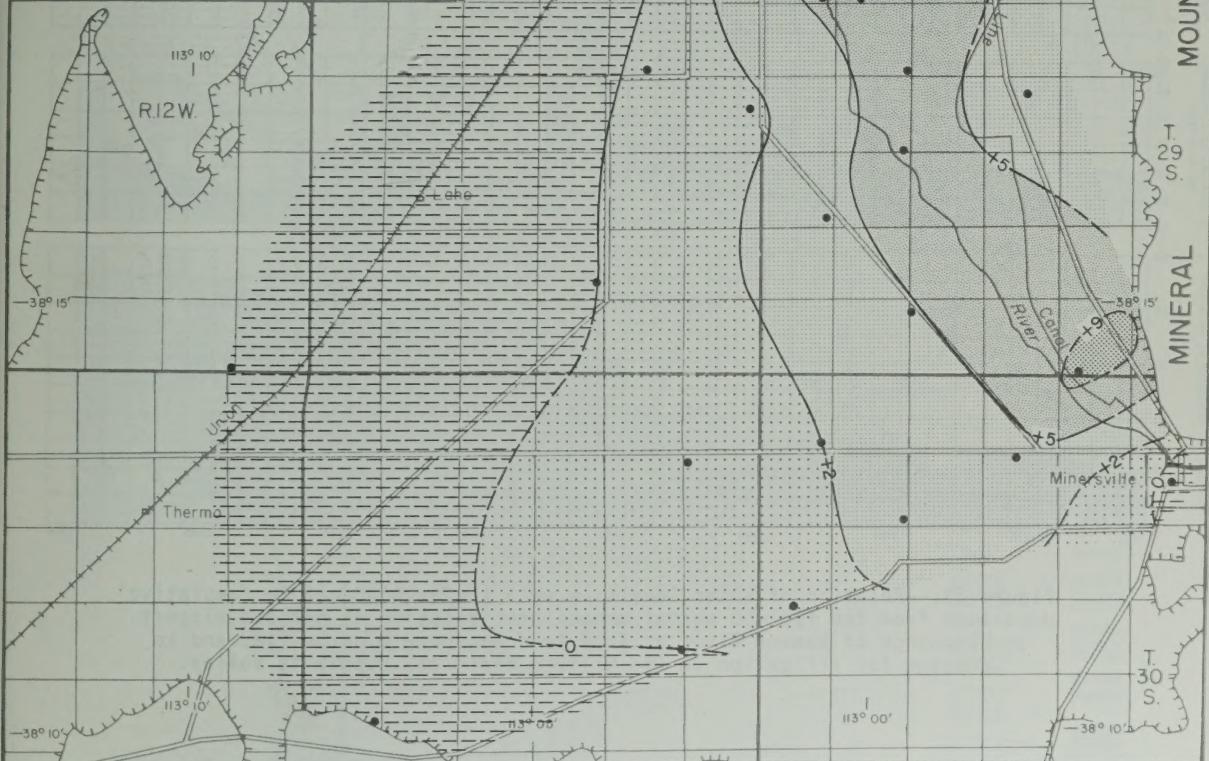


Figure 32. - Map of the Milford district, Escalante Valley, showing change of water levels from March 1969 to March 1970.

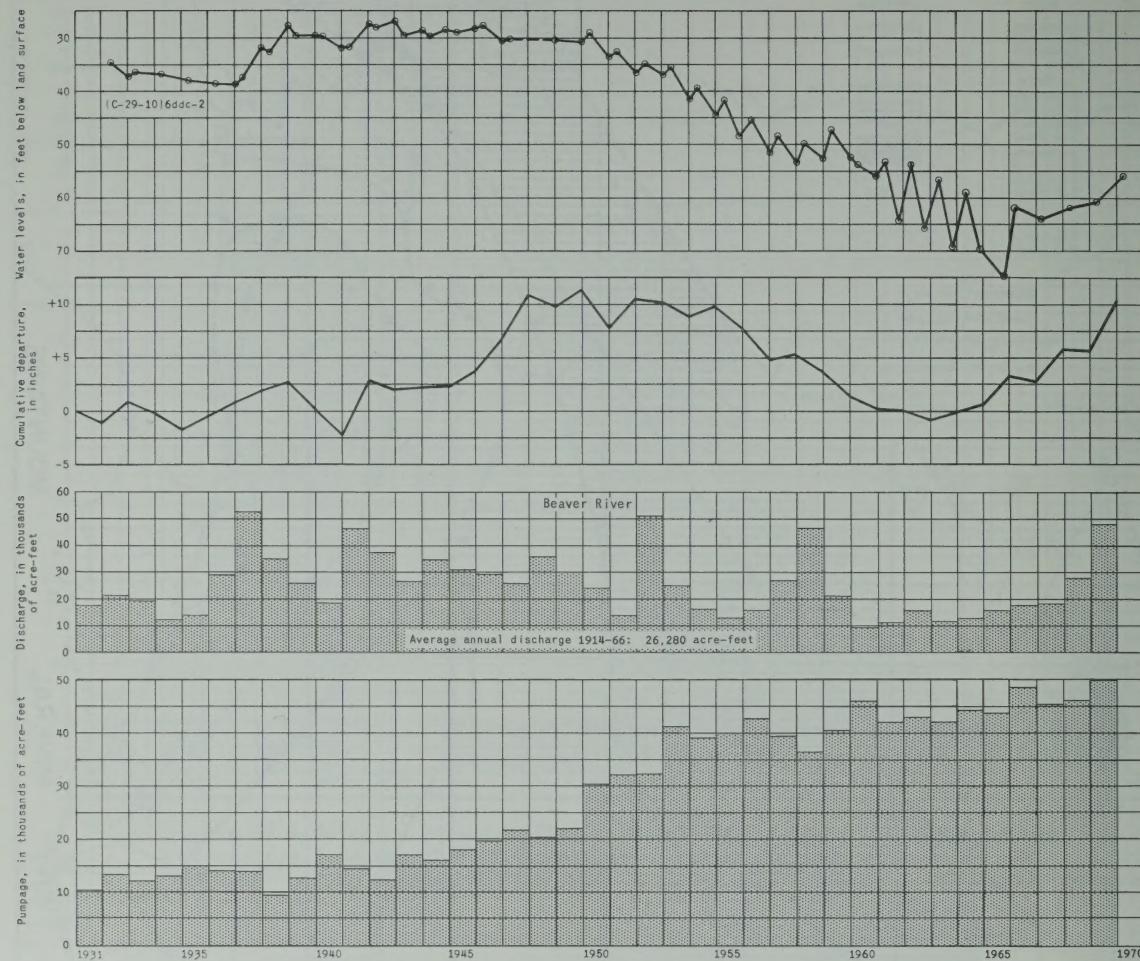


Figure 33.—Relation of water levels in well (C-29-10)6ddc-2 to cumulative departure from the 1931-60 normal annual precipitation at Milford airport, to discharge of Beaver River at Rockyford Dam near Minersville, and to pumpage for irrigation in the Milford district, Escalante Valley.

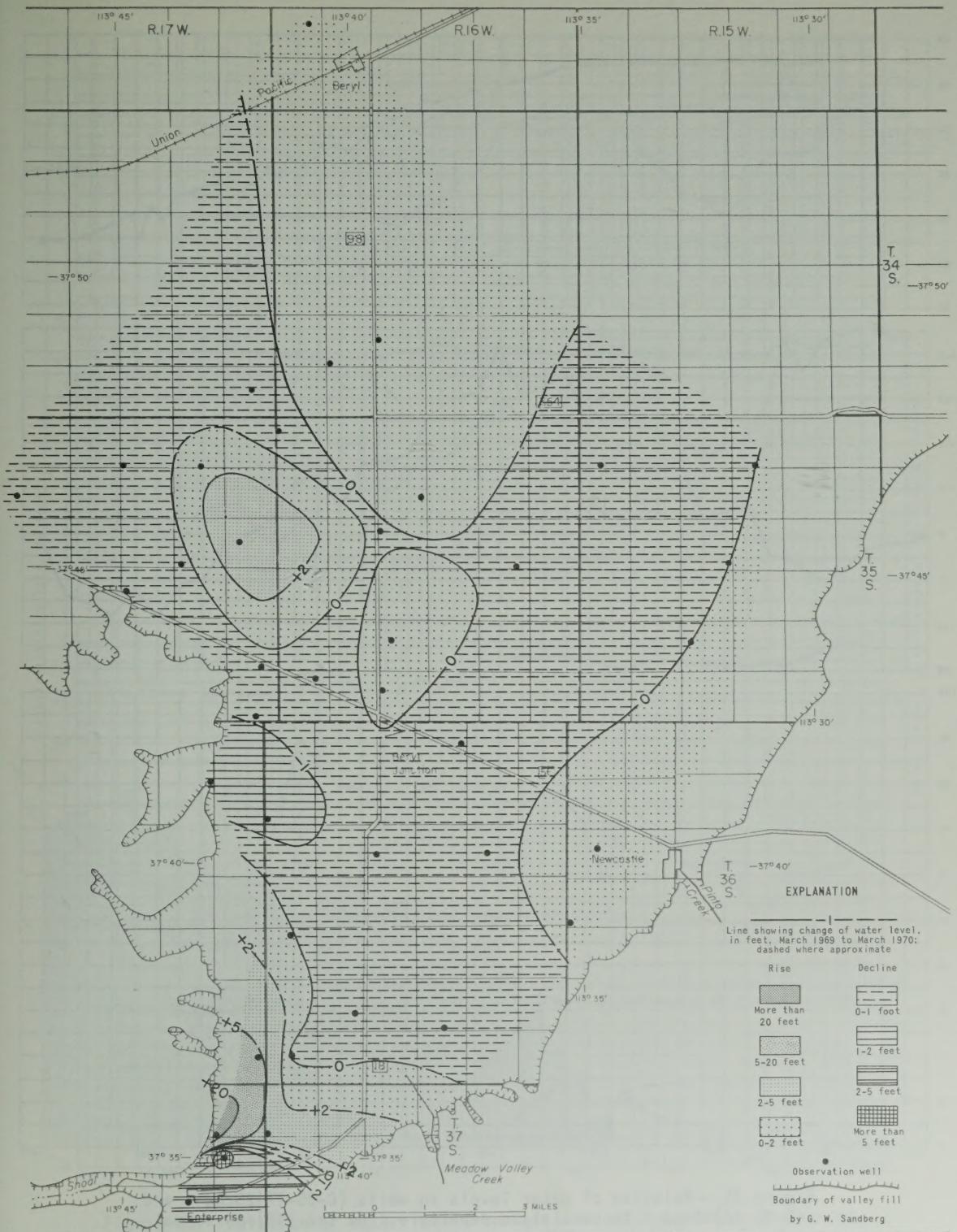


Figure 34.—Map of the Beryl-Enterprise district, Escalante Valley, showing change of water levels from March 1969 to March 1970.

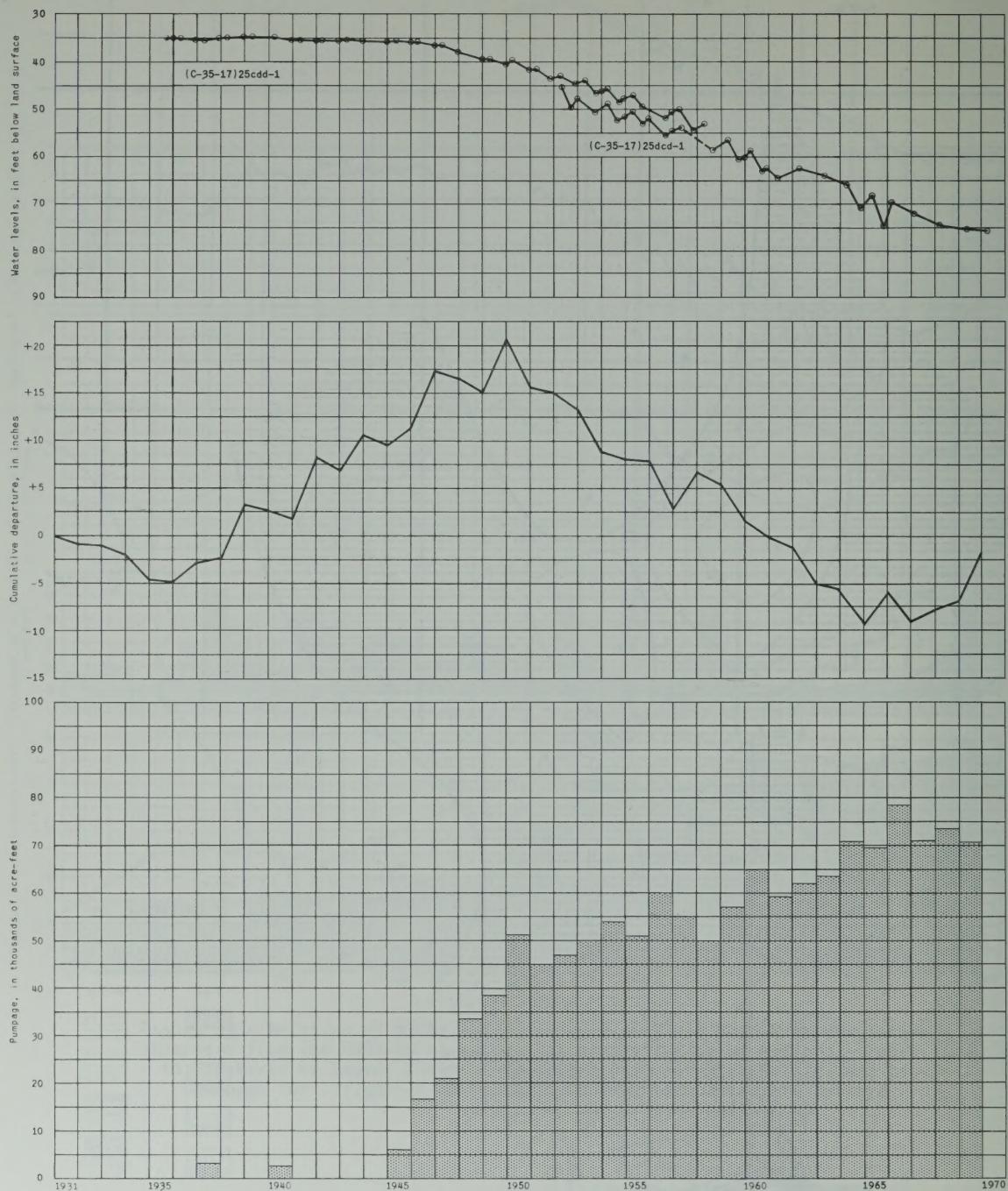


Figure 35.—Relation of water levels in wells (C-35-17)25cdd-1 and (C-35-17)25dcd-1 to cumulative departure from the 1931-60 normal annual precipitation at Modena and to pumpage for irrigation in the Beryl-Enterprise district, Escalante Valley.

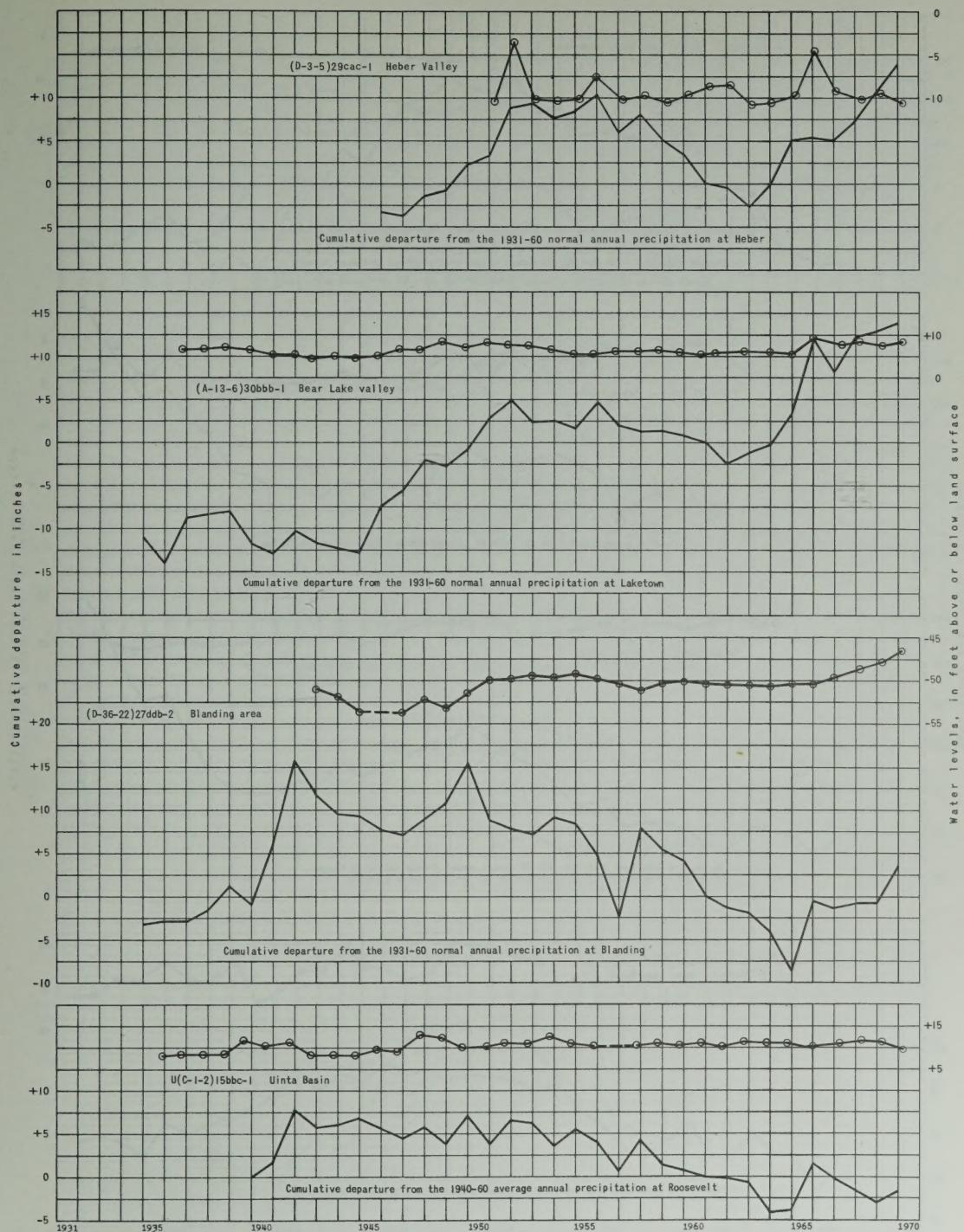


Figure 36.—Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas.

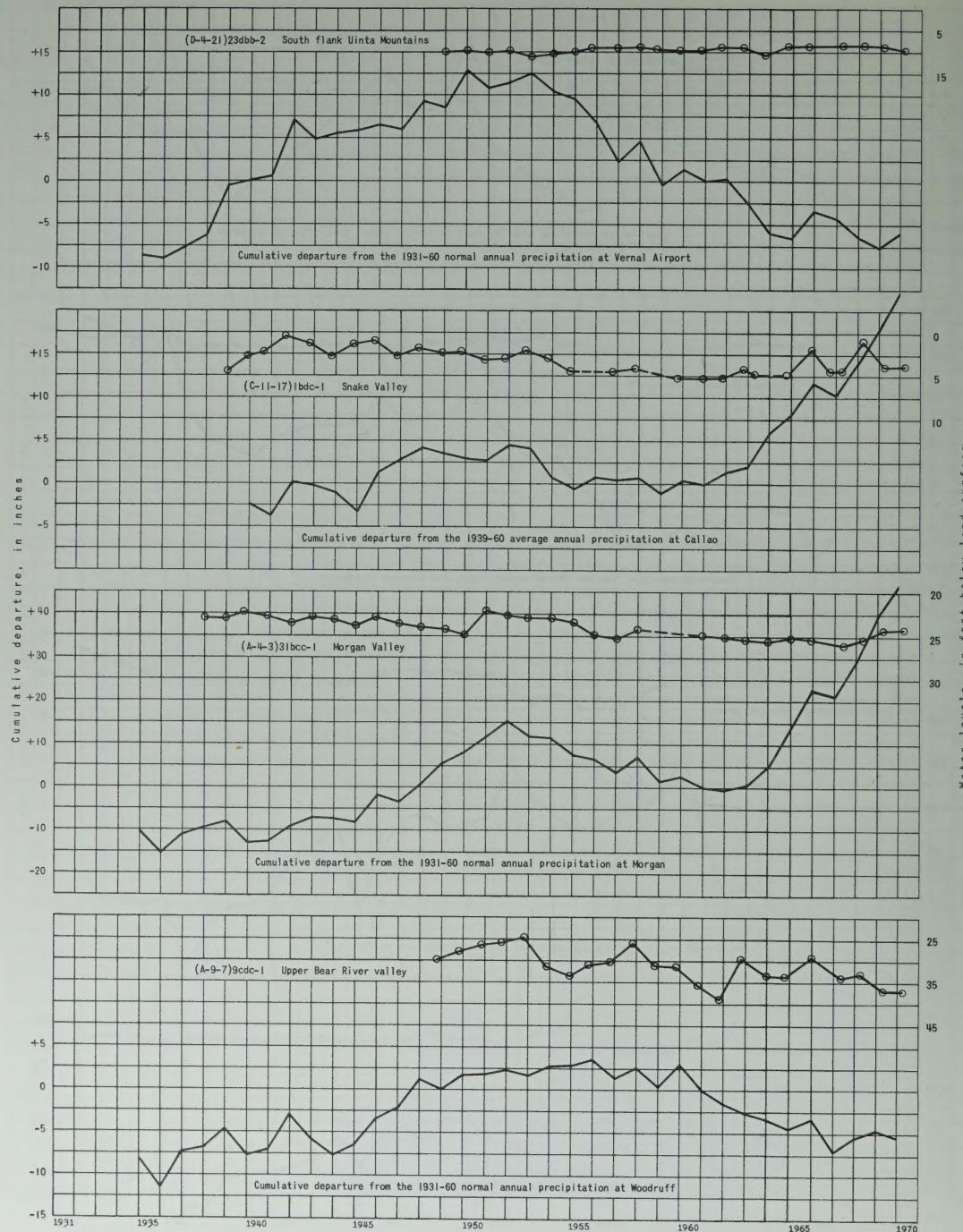


Figure 36.—Continued.

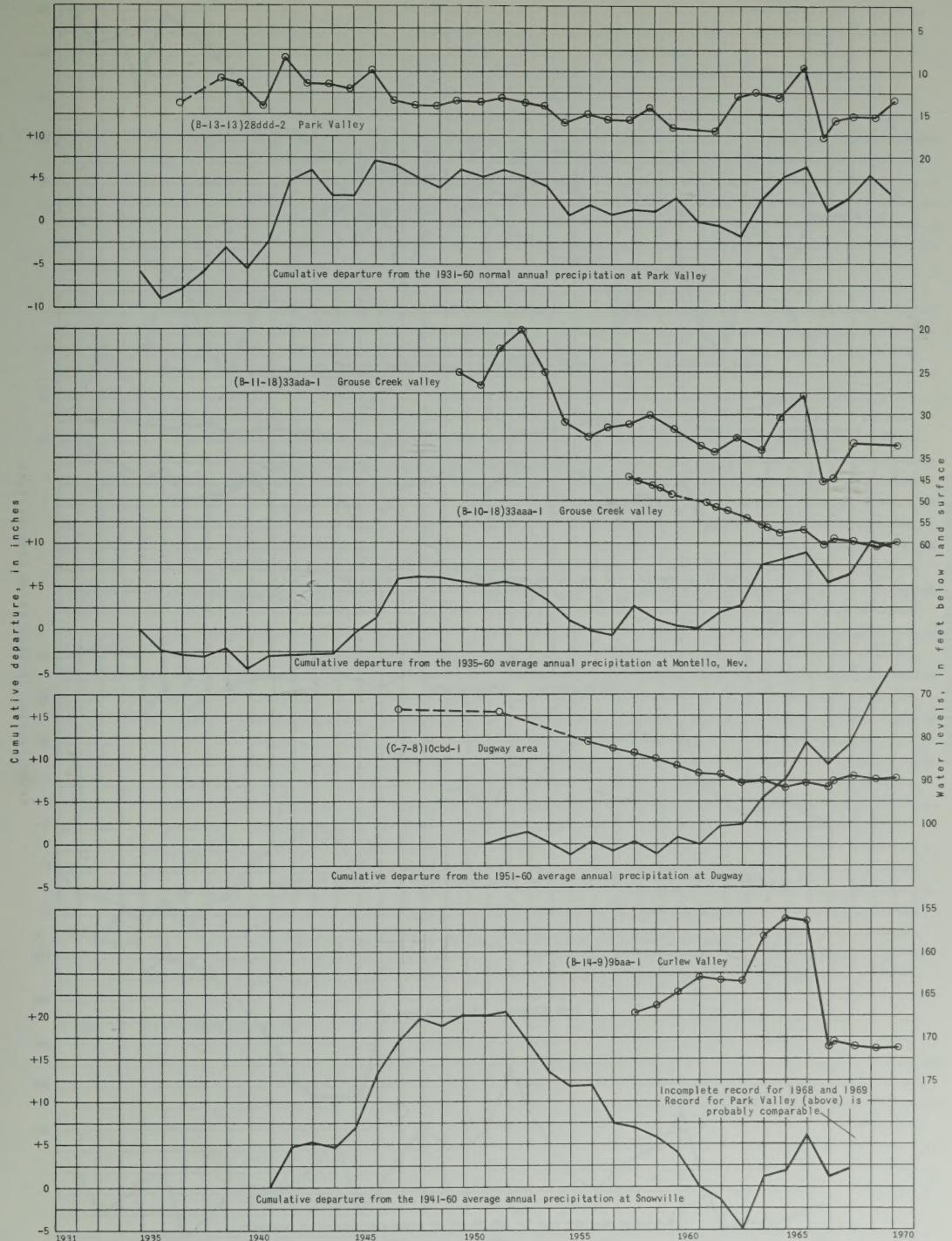


Figure 36.—Continued.

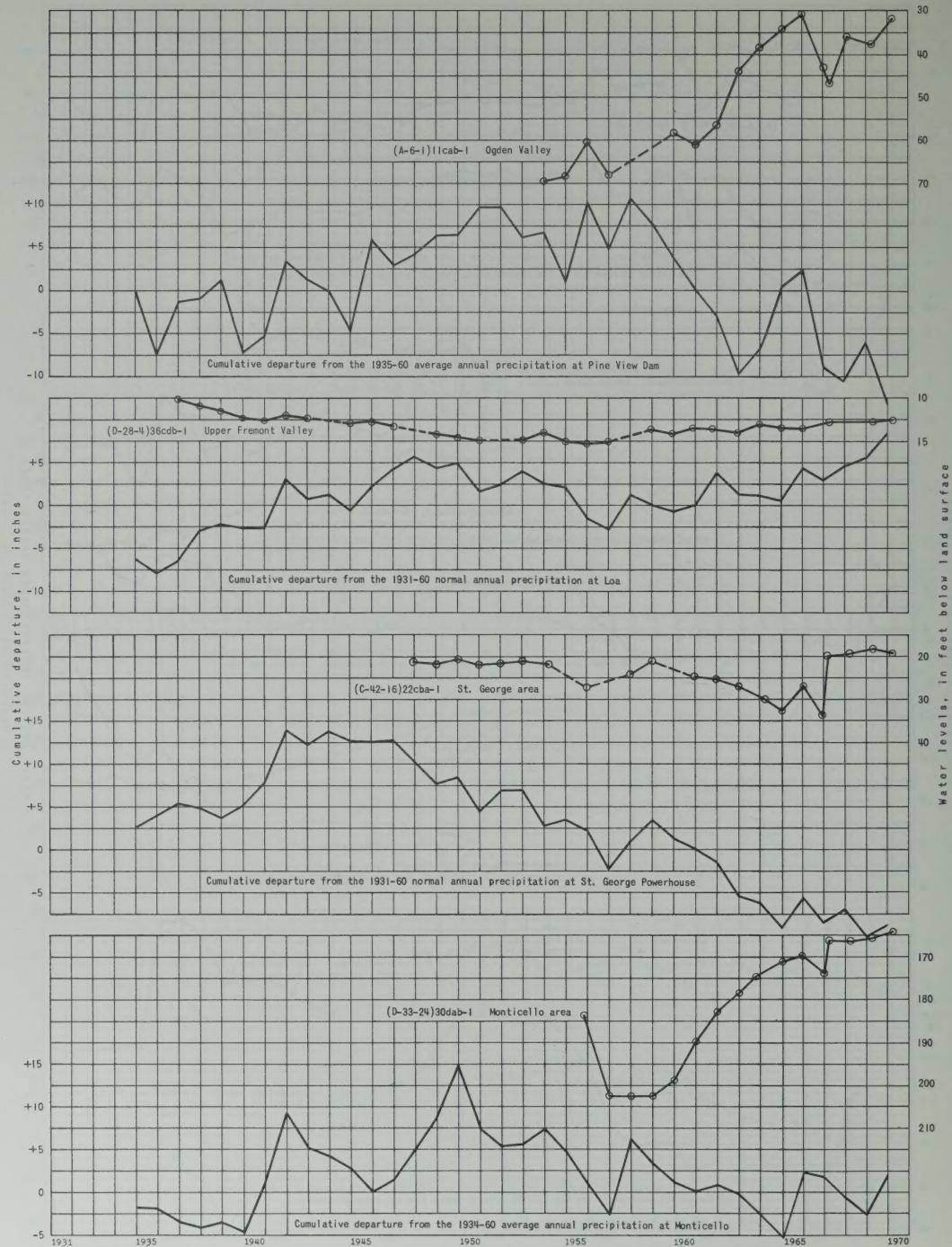


Figure 36.—Continued.

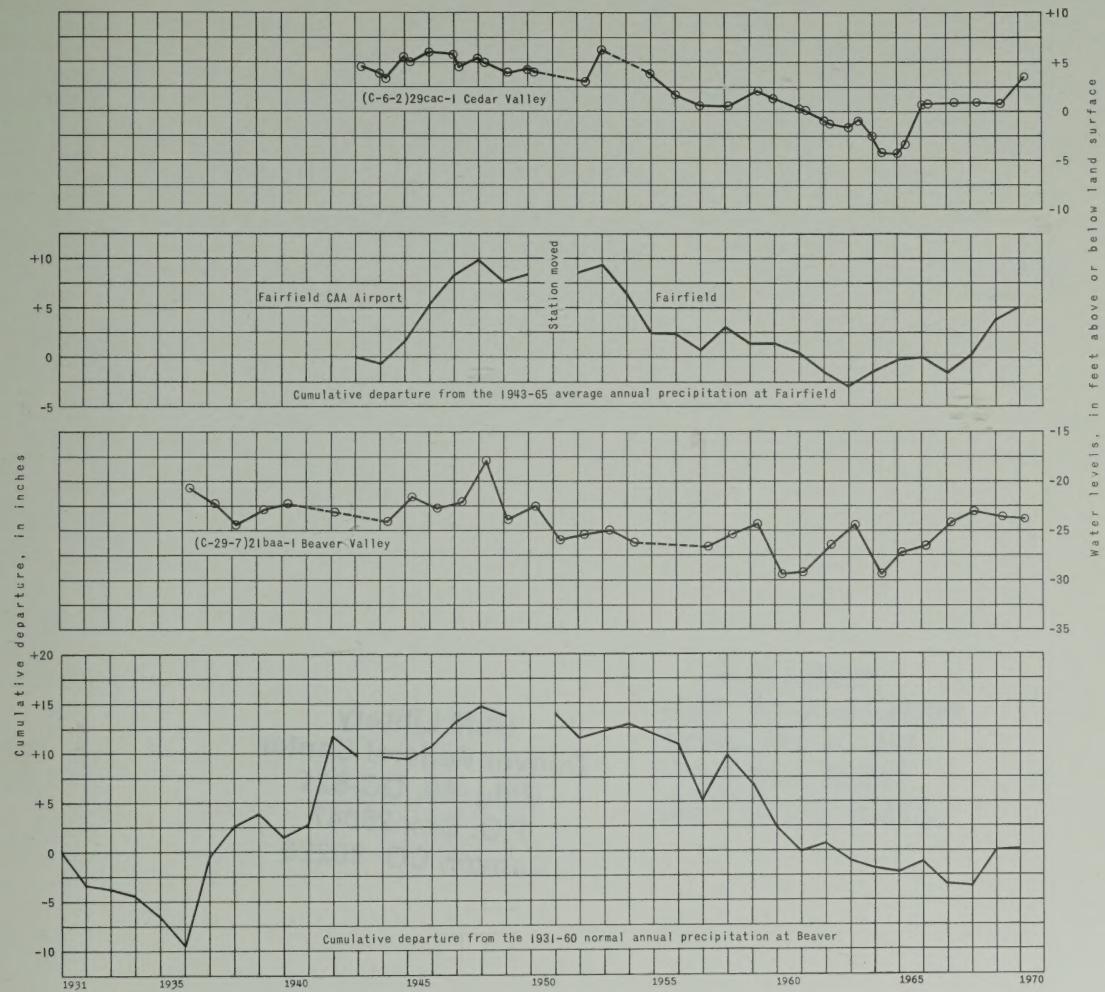


Figure 36.—Continued.

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